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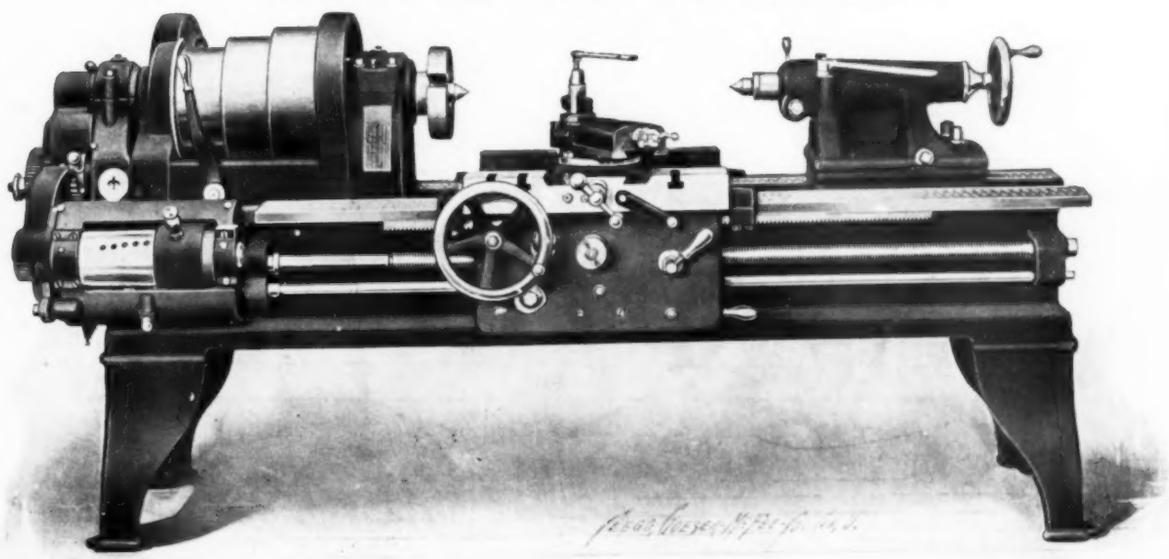

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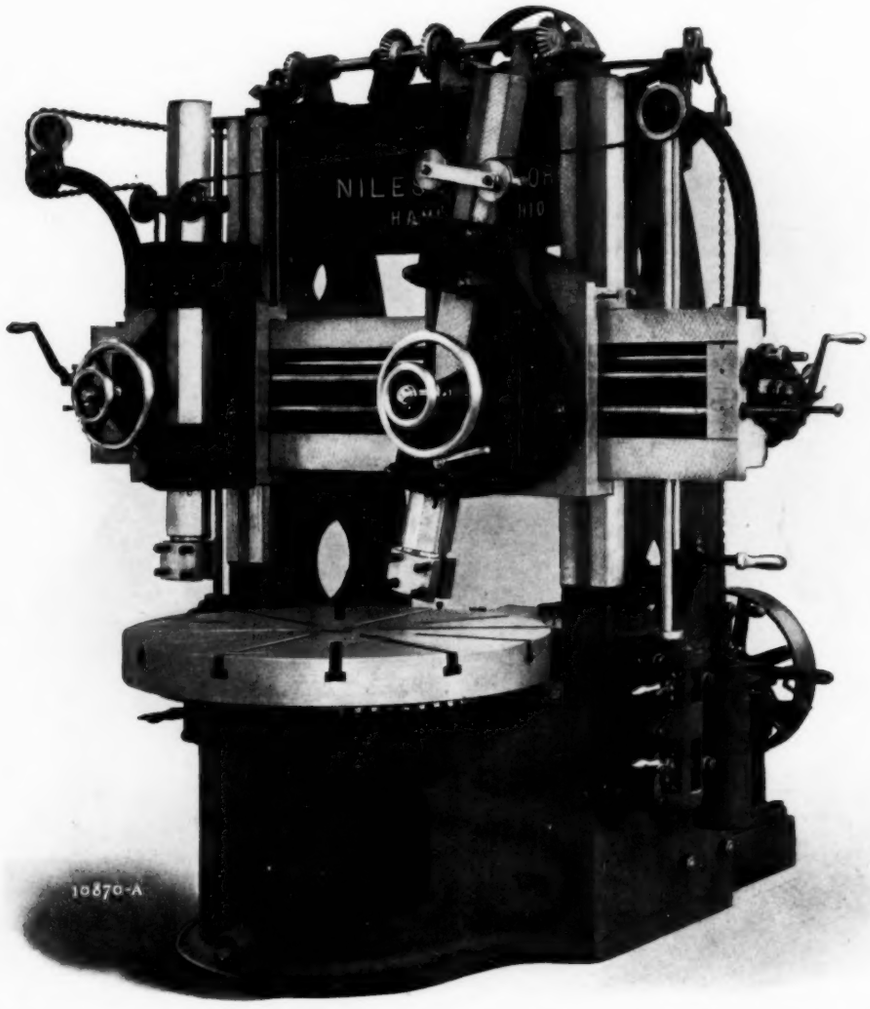

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AN ART SMITH AND HIS WORK

History tells us of a few of the famous smiths since the days of Tubal Cain, the first of whom we have any record. There was the Scotchman, Andrew Farrar, who excelled as a sword smith. He learned the art of tempering in Italy, and changed his name to Andrea Ferrara. Genuine Ferrara blades fetch high prices as articles of virtu. It is said that they are so tempered that the point of the blade can be brought round to touch the hilt, and that they will spring back straight

FIG. 1. A SINGLE ROSE

again. The temper is said to be hard, as well as tough. I have seen several of these blades, but have never known one of their owners who was willing to risk bending one of them to the extent stated. The armor smiths of the middle ages were experts in their particular lines, but were as a general thing, specialists. One of the most famous "all round" smiths the world has known, Quentin Metsys, was born in Louvain, Belgium, about 1466. As a monument to his ability as a smith, there stands to this day in the Cathedral square, Antwerp, the wrought-iron pump, known as Metsys' pump or well.

The story is told that he fell in love with the daughter of an artist, but the painter could not hear of his daughter marrying a *common* smith. Metsys, on being repulsed by the artist, asked him if an artist would be good enough for his daughter. Receiving a reply in the affirmative, he said: "I will from now on be a painter." He dropped the hammer and tongs, took up brushes and palette, and became a painter of some note. He also married the girl of his choice and let us hope that he did not regret having doused his fire.

The metal work on Metsys' pump, while very fine, is not of the startlingly beautiful and varied character possessed by the handicraft of Louis Van Boeckel, an art smith now living. He lives in the village of Lier, about 11 miles from Antwerp. His studio is about five minutes' walk from the station. In place of the usual bell pull, a small branch of a tree, forged by this artist in iron, takes its place. The visitor is cordially invited to enter. Visitors to the Van Boeckel shop are not unusual. Through that corridor, which leads to the shop at the back of the house, the greatest artists and architects of the times have passed, not to mention the countless men of title, from kings down, who have gone in person to order work and meet the smith. Here we meet the artist himself, Louis Van Boeckel. A man in the middle forties, above the average hight, with his massive chest and arms bare, dressed in shirt, trousers, wooden shoes and leather apron, his long auburn locks surmounted by an artist's slouch hat, he looks what he is—an artist in iron work. Van Boeckel is of obliging disposition, and willingly shows his visitors how he makes his really wonderful sprays of roses, tulips, etc. Picking up a piece of thin iron, he lays it on the fire, a very small one, by the way, for if the fire were too large and the heat too fierce, the leaves might be very easily burned when being heated to weld the stems on. The iron is quickly transferred from the fire to the anvil. A few sharp strokes, delivered with great rapidity, transform the iron into the rough outline of a leaf. Another heat in the fire, a few more blows with the hammer, and almost before we can realize it, the rough rose leaf is fashioned into the exact semblance of a leaf, correct in every detail; the veins stand out as in the natural leaf; even a small piece is burned out of one edge to simulate the inroads made on it by a caterpillar. No tools beyond hammer, tongs and anvil have been used. Speaking of these tools, a visitor once remarked: "You wouldn't give him 15 cents for the lot."

Leaf after leaf is made, till he has enough for the branch which he intends to construct. Next come the petals for the roses and buds. These are made as the leaves were, of flat iron, if he has it, but should he run short of flat iron, round or square seems to suit his purpose just as well. Each petal is made separately. Large petals for the outer rows, smaller for the next, and so on, decreasing in size as they go toward the center. When they are all done he collects them, and lays each petal in place, so as to form a full-blown rose. He then grasps them with a

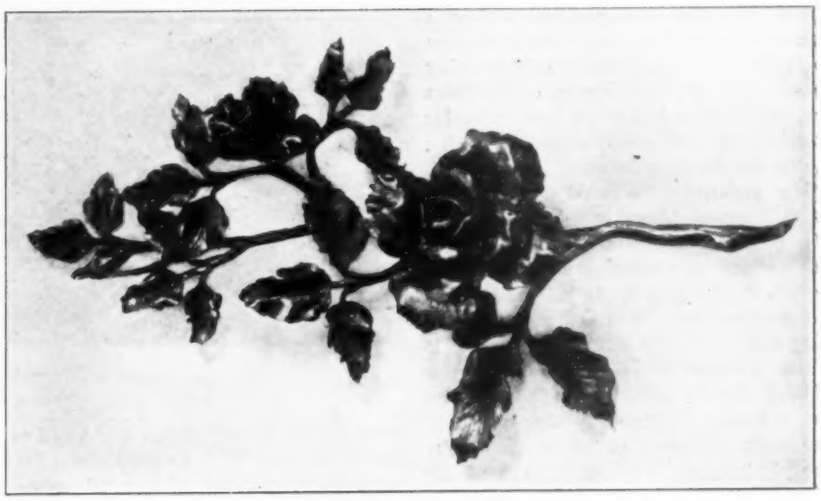


FIG. 2. A SPRAY OF ROSES

pair of round-jawed tongs, and puts the lower end in the fire.

As soon as the welding heat is reached, the work is quickly withdrawn from the fire, and a few sharp blows with the hammer welds them together. Next he takes a small iron bar and forms it into a stalk, to which he welds the rose and leaves so as to form what, in Flemish, is called a *rozen tak*, or rose branch.

Fig. 1 shows one of these rose branches. It is made of 35 separate pieces welded together. In the rose itself there are 17 petals, and in the branches, leaves and leaf stems, 18 pieces. From tip to tip the forging measures just 9 inches, and across about 6 inches, so the reproduction is a little less than half size. The forging weighs 10¼ oz. No time was taken while the leaves and petals were being forged, but the assembling and welding of the 35 pieces was done in 25 minutes. Fig. 2 is a much finer example. None of the illustrations do full justice to the work. It must be seen to be appreciated. Fig. 2 has a full-blown rose, a partly blown one and a tiny rosebud near the extreme tip at the left hand.

Van Boeckel works very rapidly, conversing with his visitors at the same time, giving a blow here, another there, apparently without method, but at each stroke of the hammer the flower assumes a more natural appearance. He is idolized by his countrymen, and his work is to be found in many of the palaces of the Belgian nobility.

Fig. 3 shows him standing beside a newel which he made for the main staircase of a Dutch baron's palace. Part of the rail is shown secured to the tail of the dolphin. The balance of the iron work for the stairway was built by Van Boeckel's blacksmith's. Of these he has about a dozen who work in a larger shop adjacent to his *atelier*. These men do the rougher work, such as fancy iron grilles, railings and gates for palaces, and iron signs for shopkeepers. However, all the designing is done by the artist himself.

Fig. 4 shows a historical trophy, which is as near as I can translate *Couronne Historique*. This was designed for the celebrations in connection with the seventy-fifth anniversary of the independence of Belgium in 1905. It is a fine example of his work.

Fig. 5 shows an entirely different style of Van Boeckel's work. The monster on the pedestal is certainly an impious-looking beast. In proof of which please note the whiskers on his knees. It was made for the last Paris exhibition. For this masterpiece he received the *Diplome d' Honneur*. Subsequently it was sold to the Chevalier de Bayet, secretary of the King of the Belgians, for $5000.

To the left in Fig. 5, suspended from the ceiling, hangs a marvelously beautiful chandelier. Behind it is a mirror, the frame of which is Van Boeckel's work.

Behind the artist is a fireplace with fire dogs in front. Besides the medals shown in the case he has two *Grand Prix* and seven *Diplomes d' Honneur* from international exhibitions.

Fig. 6 shows a duel upon a rock between an eagle and a four-footed monster. This is a magnificent piece of work, one of the artist's best. It was made for the Liège exhibition of 1905, and gained the *Grand Prix*. Besides being a marvel of the blacksmith's skill, the conception and treatment of the subject, from an artistic point of view, are wonderfully executed. The frayed wings of the eagle look as if he had tackled a tough proposition.

Fig. 7 shows an eagle about to make a meal of a bird which it has killed and carried to its eyrie. This example was made some years ago, and while good, it is not equal to that shown at Fig. 6.

Van Boeckel was entirely self taught. At no time did he receive any lessons in his work. As he himself says, "I began to make things in iron when I was a boy."

His father was a shoemaker, but a grand uncle was architect to the King of the Belgians in the last century, which probably accounts for his artistic temperament.

It is rather amusing that so many thousands of tourists visit the famous Metsys' well or pump in front of the Antwerp cathedral, but are entirely unaware that a greater genius than Metsys lives almost within rifle shot of Antwerp.

Van Boeckel made a perfect quarter-size copy of Metsys' well, which was pronounced by experts to be considerably finer than the original.

Van Boeckel's eldest son is following in his father's footsteps, and is giving promise of becoming an artist of no mean merit.

To see Van Boeckel design a piece of work reminds one of the "lightning-sketch artists" one sees on the vaudeville stage.

FIG. 3. LOUIS VAN BOECKEL, THE ARTIST BLACKSMITH

Give him an order for some work; at once a large sheet of paper is spread on the smithy floor; in a twinkling he has sketched *your* ideas on the paper; the ideas are yours, but beautiful beyond your ability to conceive them, and yet when finished, you recognize them as your own idealized. All this is done with a common piece of charcoal, without elaborate calculations, without drawing board or instruments; he sketches in a few minutes what it would take the average draftsman as many days to put on paper.

Besides iron work, he has also done some fine modeling in clay. One day, seeing a modeler at work, he thought he would try his hand at it. Having procured some clay, he sat down before a looking glass and modeled his own bust. That he was successful, the bust, which stands in his *salon,* proves beyond doubt. He also made busts of his two eldest sons.

After showing his visitors around the larger shops where the smiths are at work, Van Boeckel will offer them cigars, pick

FIG. 4. HISTORICAL TROPHY

up a round bar of iron, rain blows upon it with his hammer till it is red hot, and then light his cigar with it. Only those who have used a hammer can appreciate what this means.

Before leaving, the visitor is likely to be invited into the *salon* to crack a bottle of wine with him and his good lady. If the grapes are in season, bunches will be brought in fresh from the garden. There is no mock hospitality; all is given with a hearty good will. At last we rise to go. On shaking hands at parting, we feel that we are grasping the only hand in the world that can transform a piece of scrap iron into an art object the equal of any a jeweler has ever produced.

DIXIE.

At the Philadelphia Mint, a well was being drilled through rock, and had reached 540 feet depth when a 19-pound piece, 18 inches long, broke off the drill jar rein and wedged across at the bottom of the hole. After fishing for ten days, the contractor was about to abandon the well, when electrician P. E. Apgar came to the rescue; his successful application of electricity, as described in the *Electrical Review*, consisted in fixing on the end of a piece of 3-inch steel shaft a spool 7x9½ inches, wound with No. 18 cotton magnet wire, and covered with a copper sheathing, and connected with a No. 14 braided Okonite wire. After lowering to the bottom, the current, 1¼ amperes at 220 volts, was turned on, and the magnet drawn up, bringing with it the broken tool.

Echoes from the Oil Country—Carrying a Message to Garcia—A Young Machinist's Experiences in Delivering and Setting up a new Machine—The Search for a Man of Unusual Ability

BY W. OSBORNE

When "Carrying a Message to Garcia" had been spread broadcast across the country and furnished inspiration to tens of thousands Ira had read it along with the rest of us. After that he had heard it from the pulpit, the rostrum, the International Correspondence Schools, the Old Man, his foreman and from several other sources. While he was not very high up in the world he was not without ambition, and had often wished that he could do something fine.

"Time and chance come to all men," so it is said, and a combination of circumstances brought his chance to Ira. The foreman was away. A machine intended for a mill some distance away was at the freight depot. Ira was not very long in the shop and came from a distant part of the country, but he had been sent out on several outside jobs, and had pulled through with them all right. The mill owner was in a hurry for the use of that machine, or thought he was, and wanted it in place ready to run. He had come to the Old Man to get a man. The sending out of men was part of the work of the foreman, but as he was absent it fell to the lot of the Old Man to look after it. A clerk in the office told him that Ira had been on other jobs and so he went to him and Mr. Hyrick went along. "Ira, Mr. Hyrick wants a man who can look after getting a machine out to his mill, and getting it running." "Yes," broke in Mr. Hyrick, "I want a man who can 'carry a message to Garcia.'"

THE MACHINIST IN THE ROLE OF ROWAN

That statement shut off a number of questions that Ira wanted to ask. Rowan didn't ask questions or raise objections, he remembered. There was small chance that he should forget it for the point had been made very clear. That had been his great virtue. He had said nothing but had gone to work. McKinley had given the needed instructions and had trusted in Rowan.

"Mr. Hyrick is a very busy man and he wants you to take hold and do this job without his having to give it any attention."

"I want the best man you have," said Mr. Hyrick, "for I want that machine going at the earliest possible moment. If you have a better man than this one I want the other man."

"I have been out to your mill once and

got along all right, and I think I can get along as well as anyone else." Ira did not like the idea of being thought incompetent. It was impossible to ask questions after that. He did venture on one to the Old Man. "When am I to start on this job?" "Right away! Right away, sir! You can't start too soon or get through too soon, and don't be afraid to rush things." Mr. Hyrick answered before the Old Man had a chance to, and then turning to him began to talk of something else and they walked off together leaving Ira to his fate.

He tried to think of everything that had been said. A machine—he wondered what kind of a machine it was. At the freight depot—and he did not know which one. He was to look after getting it out and set up—where was the help to come from? He wished the foreman was at hand, but as he was not perhaps the office force could give him some information. No, they did not know who was to furnish a team or teams. They did not know what the machine was, or where it was. A 'phone call to the B. C. & K. showed that there was a machine, weight as billed 2500 lb., there for Mr. Hyrick. They did know that the Old Man had to hurry to get a train for Pittsburg, while Mr. Hyrick had gone away in an automobile with a party of friends. Judging from remarks dropped they were to take an extended trip without any settled destination. Ira began to feel that he was to stand alone, and he determined to get that machine out or burst.

DIFFICULTY AT THE OUTSET

The company did not own any teams. A transfer company did their hauling.

It might be well to explain that the shop was not a large affair. The Old Man was general manager, etc., with an office force of a man and a boy to assist him. The foreman was the head of everything outside of the office and of a whole lot of things in it. He assumed all authority when the Old Man was away. Both being now away the routine work went on as usual, but outside of that the establishment was without a head.

Ira hurried down to the B. C. & K. freight depot and found the machine and saw that it could be handled with one team. He went to the transfer company. They wanted to know who was to pay for the use of the team, and Ira said Mr. Hyrick. As he was not working for Mr. Hyrick, but for the machine company they objected. The company's office man would not bind the company and finally Ira agreed to be personally responsible for it.

All of this took time and by the time the machine was on the wagon it was too late to get out to the mill and have the team get back again that day. Ira had to agree to the added expense of overnight charges for the team and teamster or else wait until morning before getting out of town.

A thought of Rowan decided him. It was after night when they got to the mill and everything was closed up. They got supper and a place to sleep at the boarding house, and while the teamster was looking after the team Ira started to find the mill boss. No one about the boarding house knew anything about this machine. A walk of a mile and a half over a very poor road brought him to the home of the mill boss only to find that the man he was looking for had gone to a pie social with some of his children, "at the school house down the road a ways." After much inquiry made at considerable risk from dogs that could not understand why any stranger should be around at that time of night he found the school house and the mill boss.

"You have got to the wrong place. Hyrick is putting in a new mill to work out a small tract of hardwood over across the country several miles, and it must be intended for there. He has been promising me a lath machine that hasn't got here yet, and we had a row about it the last time I saw him but I don't know as it will do any good. He will go to all sorts of trouble about that little one-horse mill but will let me wait till he gets good and ready before he will get what I need."

THE RIGHT MILL IS FINALLY LOCATED

Ira did not wish to tramp on a sore spot and stayed only long enough to know that the mill boss would be at the mill early in the morning. He was started on a short-cut back to the mill. It did not seem short in the dark. He reached the mill after midnight.

FIG. 5. THE ARTIST WITH SOME OF HIS WORK AND HIS MEDALS

After seeing the machine in the morning the mill boss was certain that it was not intended for him. He told Ira where the new mill was and how to get there. He also told him that the road was very rough and so mountainous that one team could not pull the load. He was very busy but after much urging from Ira he consented to send one of the mill teams along.

The man at the new mill seemed somewhat surprised at the sudden burst of energy displayed in getting the machine

to him, and at the man sent along with it. He felt competent to do any work needed around that mill and resented interference. Ira saw and felt this, but did the best that he could with the help that was grudgingly given. It was afternoon on Friday when they got there with the machine and Saturday night found them without the job completed. On Sunday the mill did not run, and Monday was a legal holiday. The men objected to working on either of these days. They were paid by the month, and said that they did not get extra for any such work.

As they worked eleven hours as a regular thing they wanted their days of rest and recreation. The man in charge would not promise them pay for extra time in helping Ira. He claimed that he had nothing to do with the setting of the machine. Ira having been sent there, he insisted, relieved him from all responsibility in the matter.

This hostility had made it necessary for Ira to get board and lodging from a nearby farmer. The mill hands were boarded by contract by this man in charge and he claimed he did not have any room for Ira.

FIG. 6. THE FIGHT ON THE ROCK

COMPLETION OF THE JOB

Ira hired one of the men to come out and help him on Sunday and Monday. It took five dollars of his money to do it but seemed the only thing to do. The machine was ready to run on Tuesday morning, and it did seem to Ira that some of the tests were more severe than the machine would be called upon to endure in regular use. It was noon before they were satisfied and he felt it safe to go, and it was nearly dark before he got over to the big mill. For several reasons he had walked over. Had it not been for carrying his tools it would have been nearly as easy to walk as to ride, but besides that his finances were nearly exhausted.

He found another man from the shop at this mill. He was there to set up the lath machine. He gathered the information from this man that it was the lath machine that Mr. Hyrick had been in such a hurry about, and that it had been at the R. P. & H. V. freight depot at the time he had gotten the other machine from the B. C. & K. He turned in and helped get it going and they returned to the shop together.

The Old Man seemed relieved to find that he had not gotten entirely lost with the machine, or broken it or done some other horrible thing while it was in his possession. This was very evident and did not add to Ira's peace of mind.

The foreman seemed much amused at the mix up. The shop men were hilarious. You know how it made Ira feel.

THE MESSENGER'S REWARD

When it came to a settlement of wages and expenses there was trouble. Mr. Hyrick took the ground that he would have hauled this machine out with one of his own teams at a very slight expense. By going directly there the distance would have been so much shortened that one day would be sufficient for the round trip. In view of this the hauling charges should at the very least be cut in two. Besides that his man was entirely competent to set the machine without outside assistance, and in doing so would have saved all that expense. Ira urged that he had used his best endeavors under the circumstances. On one thing Mr. Hyrick took high moral ground and was inflexible. He would not pay for any work done on the Sabbath day. He had noticed, so he said, that such work was unlucky. Perhaps by an oversight he figured in Monday also as an unlucky day not to be paid for.

Through all the discussion Ira never mentioned Rowan and his errand, or the fact that he had tried to do likewise in his humble capacity. Some way or other he did not think it a wise thing to do under the circumstances.

Some items of expense he had not mentioned after he had seen the view taken of himself and his trip, and in the roundup he found that he had paid for the help of the men the two days, for his own board, and was several days short in his pay. He went out wondering if Rowan got any pay for carrying that message, or whether he had to pay his own way while he did it. "By gum," he muttered to himself; "if ever I try to carry another message to Garcia I will be sure that it is McKinley that is giving me the order, and not some miser that is just trying to get something for nothing. If McKinley had been as

slack in giving orders as these fellows were with me, Rowan might have gone to the Philippines looking for Garcia. I don't believe it would be very hard to find enough Rowans to go 'round if there were more McKinley's hunting for them. I begin to think that a lot of this hollering comes from fellows who want to pick up their Rowans at bargain-counter prices."

FIG. 7. THE DINNER IN THE EYRIE

A GOOD MAN WANTED

A financier who was not a mechanic found himself in possession of a machine shop. His efforts with it were not as successful as he wished them to be. He had several different men in charge at different times, but they all seemed to fall short of the requirements. Not knowing of such a man as he wanted in the vicinity, he determined to go out into the big world in search of one. All he wanted was to get a man who was a thorough mechanic, who knew all about the practical part of a machine shop, and who could design anything needed, and make it a little bit better than anything else in its line on the market and systematize the work, and so manage the help as to keep the costs down to the lowest point, and keep the office work in such shape that the state of things could be told at a glance, and be able to meet any customers or prospective customers in a suitable manner, and be able to go into any part of the country and look over machinery, and know the power required to run it so that contracts could be entered into safely to furnish that power without furnishing an excess, and be and keep posted on everything of importance in the mechanical line, and be a close buyer and a good seller, and be full of energy and push, and have a few other accomplishments which come handy around a manufacturing establishment, or an engineering works, and be of good address and appearance, and able to "mix" well. The requirements may not have been put into words quite as definitely as the above, but that is about the substance of them. It is believed that he stood ready to pay $125 per month for such a man, and might even be induced to pay $150 per month for a fine specimen.

In his search he visited the offices of one of the largest manufacturers in this country. He had heard that such companies are always ready to help along deserving men, and thought that he might be able to furnish a place for some talent for which they did not have an opening. His statement of the case was listened to carefully, but they could not help him. On the contrary, they told him that if he found more than one such man they would be very willing to take care of the surplus and furnish it with good places.

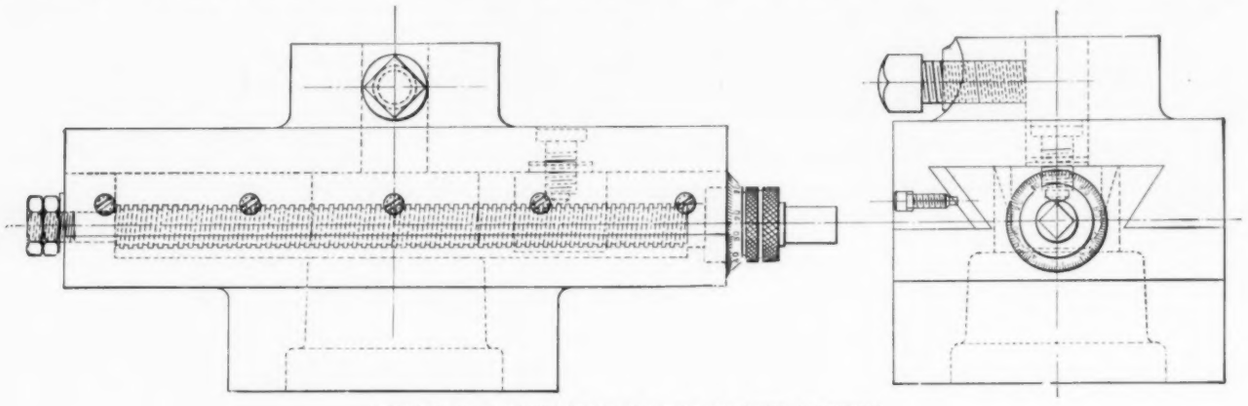
"What would you be able to pay in case I send such a man to you?"

"We would be very glad indeed to pay such a man as you describe $10,000 a year, and would think him cheap at that." That answer was founded on experience.

Boring and Facing Head for Milling Machine

EDITORIAL CORRESPONDENCE

The accompanying illustration shows a boring and facing head for toolroom milling-machine work which has been



BORING AND FACING HEAD FOR THE MILLING MACHINE

found very useful at the works of the Cadillac Motor Car Company, Detroit. The chief use of the attachment is in truing up drilled jig holes. The hole having been in the first instance drilled small, a small boring tool is inserted in the holder and the jig having been correctly located by the horizontal and vertical feed screws of the milling machine or by other means, the hole is enlarged and brought to its true position by the boring tool. For some purposes a micrometer dial on the screw is also found useful and is provided. A star feed is also provided by which the attachment is made useful for facing. F. A. H.

A "Jig" Made of Plaster of Paris

We have referred to the use of plaster of paris for pattern plates for the Bonvillain and Ronceray molding machines described in various issues of the AMERICAN MACHINIST, and we illustrate herewith an unusual application of this material. The firm mentioned uses in the appliances for the construction of pattern plates a number of crooked, thin castings, a sample of which is shown in Fig. 1. In order to overcome the difficulty of clamping such castings in quantity on the table of the planing or milling machine, the manager of the Bonvillain-Ronceray Works in Paris was led by his experience in their special line of work to try the experiment illustrated in Fig. 2. He placed on the table of an Ingersoll milling machine a number of the crooked castings and then placed four planks along the sides and ends of the table, filled up the holes in the table with pieces of wood, and then poured the space between the boards and around the casting with plaster of paris and let it set for a few minutes. The result was that the pieces were not only clamped, but were supported all over, and there was no tendency to spring under the pressure of the tool. The method was such a success that it has been adopted in the works for all jobs of a similar character to the one shown, and it is found that a lot of time is saved. Messrs. Bonvillain and Ronceray state that the plaster is very cheap and sets in a few minutes, the only drawback being that the table of the machine gets a little dirty after the plaster has been broken in pieces. It is quite possible that this method can be applied with advantage in other places, though in some perhaps local conditions will militate against its use.

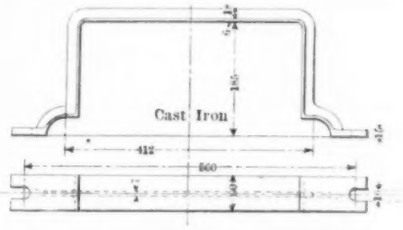


FIG. 1. ONE OF THE CASTINGS TO BE MACHINED

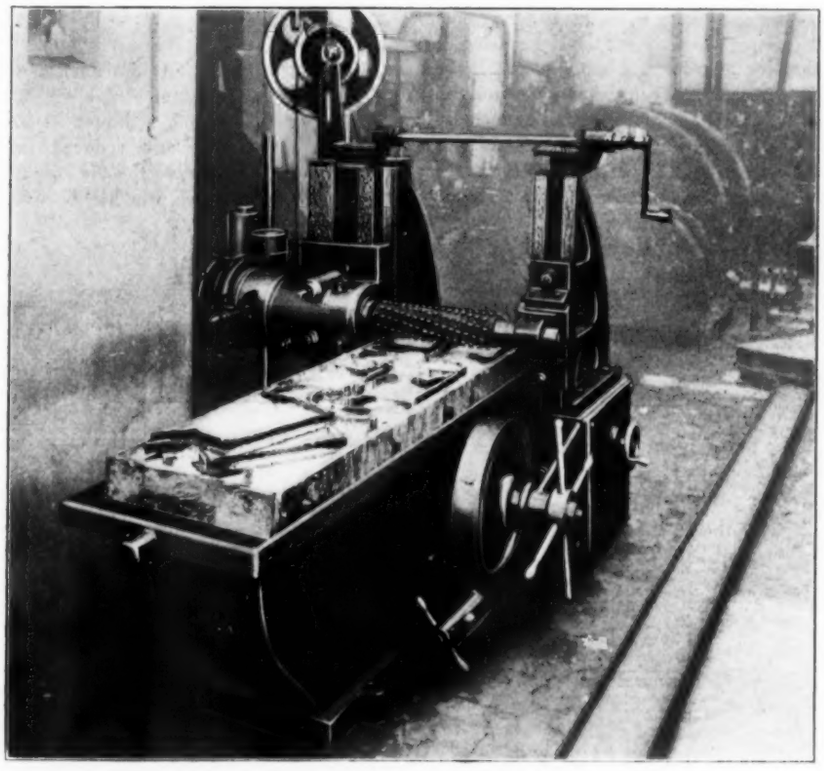


FIG. 2. WORK HELD ON THE MILLING MACHINE TABLE BY PLASTER OF PARIS

Legal Notes—Restraint of Competition—Personal Obligation of Stockholders—Use of Name, when Justifiable, and when Otherwise — Disagreement of U. S. Circuit Courts of Appeals

BY E. P. BUFFET

The question whether the acts of a corporate official bind him personally, either as an officer or as a stockholder, is touched upon in an interesting case on which an opinion has been handed down by the U. S. Court of Appeals, sixth circuit. Its presentation, so far as of interest to us, indicates approximately these circumstances:

Some years ago the Blank's Safe and Lock Company had been in business in Ohio, members of the Blank family being stockholders and officials or leading persons. The company sold out to a combine which embodied the name Blank with others in its title. The terms of sale committed the absorbed company to dissolution and, of course, against competition with its absorber. Two of the Blank family became president and treasurer of the combine, but later they were deposed from their offices, resigned from the directorate and organized a new Ohio concern, called the Blank's Safe Company, which entered into a competitive business. The combine sued to restrain the competition under the form in which they were said to be carrying it on.

The court holds that such agreement against competition as these persons may have assented to on behalf of the old Blank's Safe and Lock Company did not bind them individually. An officer's acts for his corporation are like those of an agent, and it is well settled that agents are not, in general, personally liable on contracts they make for known principals. Nor, as a rule, are stockholders individually bound in such a case, by a corporation's agreements.

The right to use the name Blank's Safe Company is sustained, since "in the absence of contract, fraud or estoppel, any man may use his own name in all legitimate ways, and as a whole or a part of a corporate title." But an injunction is granted, prohibiting this style unless it be accompanied with explanatory matter, tending to prevent misleading impressions. The court seems to regard even the designation of the product as "Blank's safes" to be permissible if thus properly explained.

146 Fed. Rep., 37.

An interesting distinction, and apparently a considerable difference of opinion, is involved in a closely related case decided in the Court of Appeals of the

seventh circuit shortly before the above was passed on in the sixth. The safe consolidation had been sued by, and in return had filed a bill against a concern incorporated in Illinois as the Blank Safe and Lock Company, which is not shown to have contained as a member anyone by the name Blank, but which is claimed to have been engaged in selling the product of the Blank's Safe Company, of Ohio, which latter the Blanks themselves had organized. The business predecessors of this Illinois concern had been representatives for the consolidation. The court holds its use of the name Blank to have been unjustifiable. The judge delivering the opinion in the Ohio case (sixth circuit) alludes to this decision, at that time rendered, but not yet published, though possibly examined by him in full, and seems to think that it may be distinguished. But a comparison of the two conveys an impression of sharp contradiction. The Ohio company was not indeed so involved in the Illinois suit that its rights could be adjudged there; yet somewhat emphatically, although incidentally, they are discussed and opined upon. The seventh circuit (Illinois) court considers them to underlie the case at bar before it and seems to think that the relation of the managers of the original Blank company to the combine was such as to preclude them from rightfully setting up a rival using that name. Thus, while agreeing on the legal principles involved, the sixth and seventh circuit Courts of Appeals appear to be at variance on the application of the law to a given state of circumstances, so far as presented to them respectively. As matters now stand, the Ohio concern naturally retains such benefit as it has derived from the decision in the sixth circuit, while the Illinois company has the disadvantage of that in the seventh circuit. But perhaps the case may reach the Supreme Court of the United States, as it ought to, one would think. The Circuit Courts of Appeals were formed some years ago to relieve that tribunal from many of its burdens, and qualifiedly they were made courts of last resort for certain sorts of cases. Into the question whether these suits are appealable to the Supreme Court we shall not enter, but their present condition is grotesque.

143 Fed. Rep., 231.

The Carnegie Steel Company, according to report, will, when its new open-hearth furnaces are completed, abandon the manufacture of bessemer steel at its Duquesne works. It has two 10-ton bessemer converters in use. It is expected that the 18 new 60-inch furnaces which are being erected will be in operation early next year. After their completion, room will be obtained for still more furnaces by the removal of the bessemer converters. These changes are indicative of the progress of the open-hearth process.

THE LOOSE PATTERN AND THE MACHINE-MOUNTED PATTERN

How the Output Was Quadrupled and the Labor Cost Quartered by Molding a 150-pound Casting by Machine

The great saving in labor and time effected by the use of the molding machine on small and medium sized castings and the enormous increase in output due to the machine, make it appear strange that many firms are still molding from loose patterns even when these patterns are running for months at a time, and in several known cases they are being used all the year round; the loose metal pattern lasting only a few months when in constant use and having to be constantly replaced. So that besides the above advantages due to the use of the molding machine there is still another—that of prolonging the useful life of the pattern indefinitely.

The larger sized machines are still less used than the small and medium, several instances being known where all the small pieces are made on machines, but the large and sometimes the principal castings are made from loose metal patterns. All the advantages gained by using the machines for small work apply to a greater extent to the larger and most important pieces.

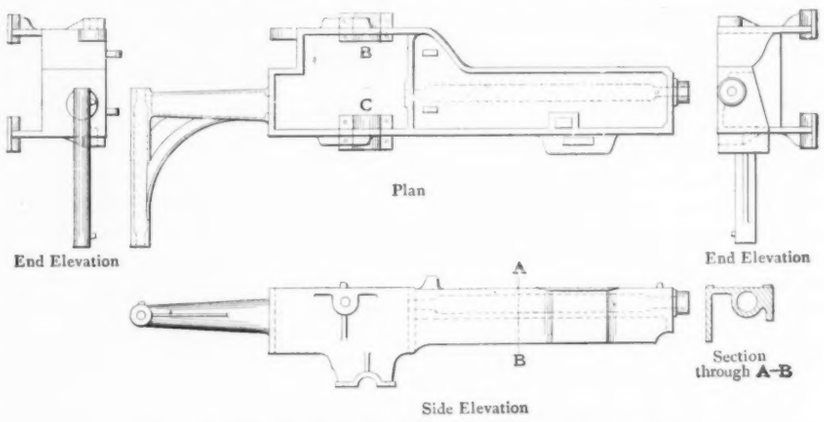


FIG. 1. THE CASTING TO BE MADE, AN IMPLEMENT FRAME

THE CASTING ON WHICH THE SAVING WAS EFFECTED

An example showing a simple instance of increased output and reduced labor costs may be taken from the views shown of an implement frame, Fig. 1. This piece is 5 feet 6 inches long, 22 inches wide, 12 inches deep and weighs 150 pounds. It was made for some years from a loose metal pattern. This pattern was in every respect a really good pattern, no expense

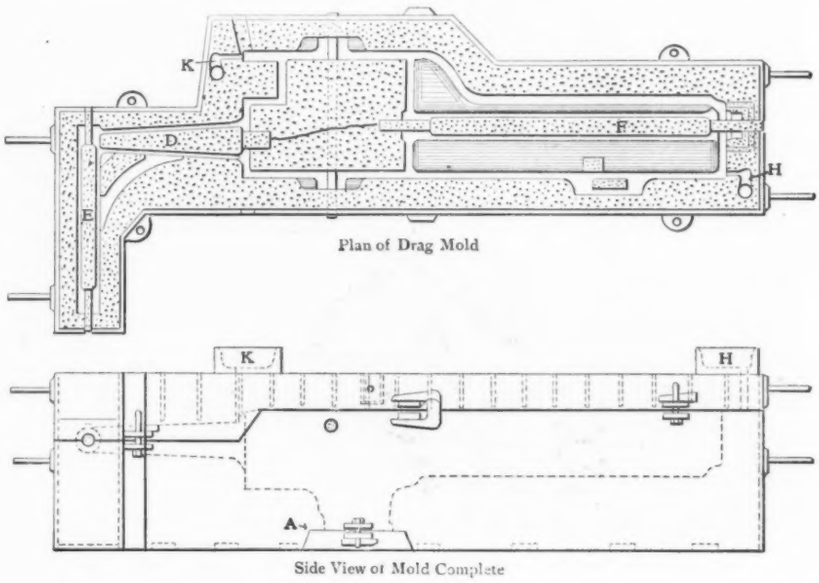


FIG. 2

being spared in preparing it for the molder's use; the output was three castings per day at a labor cost of 3s. 4d. each. Fig. 2 is a plan of the drag and side view of the complete mold. Some thousands of castings were made from constantly renewed metal patterns, the rapping of such a piece soon playing havoc with the pattern, splitting it eventually, it being then replaced by a new pattern made from the master.

In the plan, Fig. 2, which shows all cores set, it will be seen that there is

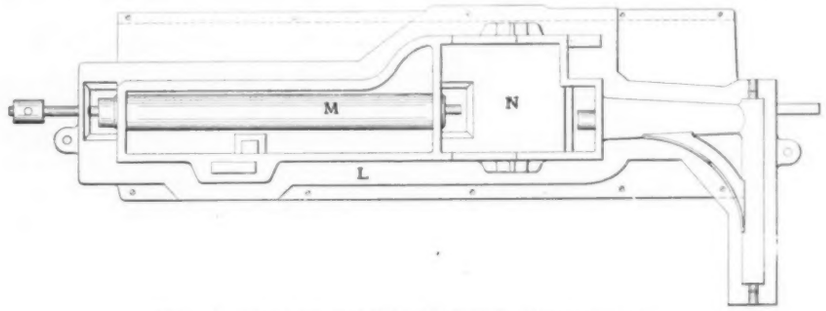


FIG. 3. PLAN OF MOLDING MACHINE AND PATTERN

a considerable amount of coring to be done.

MOLDING BY HAND

When molding from the loose pattern the pattern is first set on a suitable turnover board which fits snugly around the joint line of the pattern. The mold is next rammed up in the usual manner, a joint being made, however, at the feet *A*, Fig. 2. The flask is provided with a small covering box having the usual pin and hole guides, and after forming a parting at *A* the small flask is rammed up and lifted off to allow the two loose parts of the pattern *B C*, Fig. 1, to be withdrawn. The covering

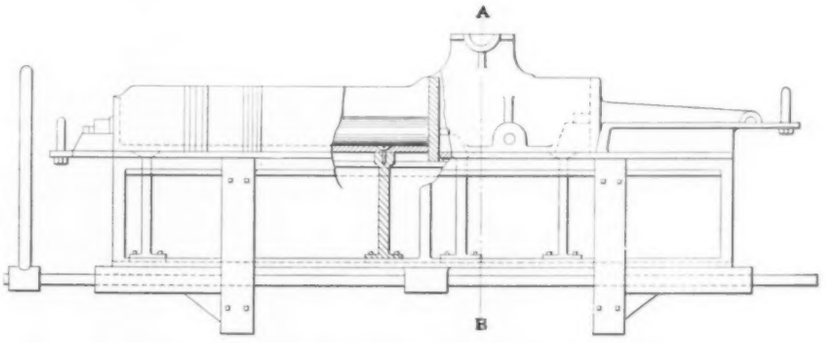


FIG. 4. SIDE VIEW OF MOLDING MACHINE AND PATTERN

flask is then replaced and secured with two cotters and the drag, together with the turnover board clamped to it, is rolled over and the board lifted off. The joint is next trimmed and the top flask placed in position and rammed up and lifted off. The pattern is next rapped with a bar which is placed into suitable holes drilled into the pattern for the purpose. Considerable force has to be used in loosening this pattern, this being in fact the principal cause of the quick wearing out of metal patterns generally, as the rapping holes gradually become enlarged and finally the patterns split through these holes. The various tube cores are now set in their respective prints. The core *D* is set on two tinned pipe nails, a small chaplet securing against upward lift in the top part. The cores *E* and *F* are also provided with chaplets in the top part, set in the center of the length of the core, to prevent any tendency of the core to lift when the mold is being poured. The mold is gated at two points *H* and *K* and is poured with two one-hundredweight ladles of metal.

MOUNTING THE JOB ON A MOLDING MACHINE

The mounting of the implement frame on a suitable molding machine is a task which requires a lot of thought and patience, especially if, as in the present instance, the whole of the work is done in the foundry tool shop, a building opening into the molding shop with sliding doors, and therefore convenient for continual inspection of the work in progress, and also handy for making trials when the mounted patterns are considered ready for the foundry. Fig. 3 is a plan, and Fig. 4 is a side elevation of the machine, and pattern. *L* is the stripping plate and *M, N* are stooled inside strippers. Fig. 5 is a section through *A B* of Fig. 4. *P* is the pattern; *R* machine frame; S pattern carrier; *T* stool support; *U* bearing pattern (loose); *V* core-print bar; *W* locking and lifting handles.

Figs. 6 and 7 are plan and side views of the plate used to form the drag part of the mold. The mold as made on the machine has the opposite side up to the hand-molding job, this "way up" giving better results, but having been found to be impracticable when working from the loose pattern.

THE COPE

Figs. 8 and 9 are plan and sectional side views of the cope rammed on the machine and lifted off by means of a hand hoist, the beam *X* being used for that purpose, and also for turning the mold over in order to set cores *Y Y*. The core print for these cores is shown at *V*, Fig. 5. This beam is simply sprung on to cored holes in lugs cast on to the flasks, the ends of the beam being made to fit these cored holes, as shown at *Z Z*.

THE DRAG

The drag part of the mold, with cores

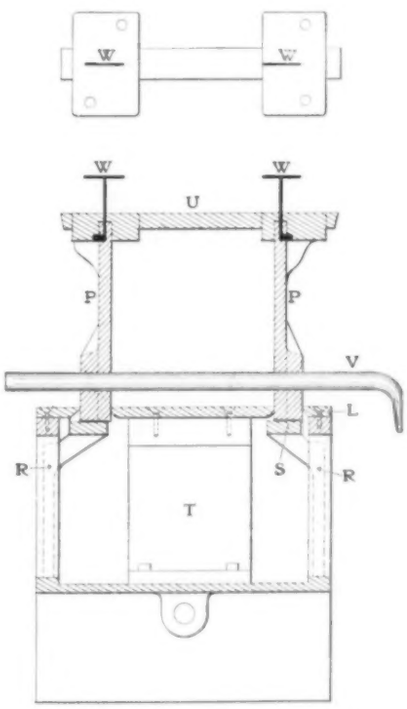


FIG. 5. SECTION AT A-B OF FIG. 4

set, is shown in Figs. 10 and 11. The tube cores are held in their respective positions without chaplets, small projecting pieces of core being formed in these cores for this purpose. These cores cut through the thickness of metal, and firmly support the cores while the mold is being poured. These projecting cores are shown at *Z Z Z Z*. To describe the methods employed in fitting up this pattern on the machine, and also the making of the stripping plates and drag plate, would occupy too much space. These latter pieces were, however, formed without having patterns of them, the only patterns used to aid in their formation being the master pattern of the casting to be made and the flask pattern. The latter was made to leave about 1½ inches of sand around the pattern.

MOLDING ON THE MACHINE

To mold a frame the plate to form the bottom is well polished, and some fine

sand sifted on, as there is considerable lettering on the flat surface of the drag, not shown on sketch. The drag flask is lifted on to the plate, and the pair clamped together and rammed up, and rolled over on a prepared bed and rubbed solid. The plate is rapped and lifted off, and the cores set. The cope part is made similarly, the sand being tucked well around the bars in the flask, and a joint made at the top of the bearing pattern at *J*, Fig. 9. When this is done, the bearing pattern is lifted out of the mold by the handles. These handles are turned a half turn, unlocking the pattern, which is held firmly while the handles are in the locked position, so that there is no danger of their being raised when the mold is being rammed, and thereby causing the centers *Y* and *G*, Fig. 9, to raise and cause trouble when the castings come to be assembled in the fitting shops.

The lever of the machine is next turned, drawing the pattern, and the cope lifted off with the beam and turned over, and the two bearing cores placed in position, blacking dusted on and the cope lowered on to the drag and clamped with small, cast-iron wedge-shaped clamps to suitable lugs shown on the cope and drag. The core 2, Fig. 8, is set, and a flat top rammed up on a separate plate is dropped to cover the bearing; this completes the molding.

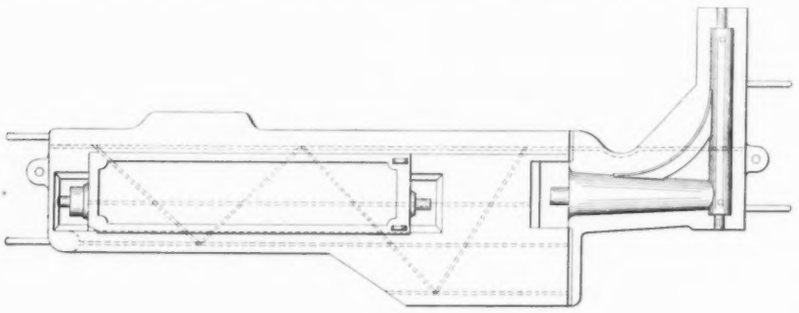


FIG. 6

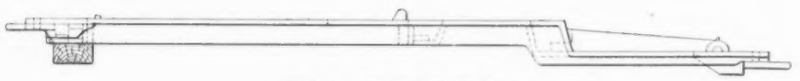


FIG. 7 PLATE FOR DRAG

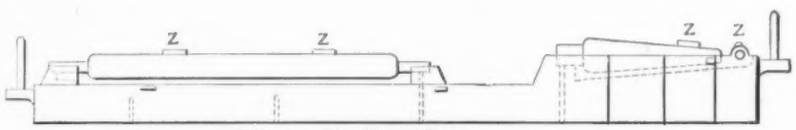


FIG. 10 Side View of Drag

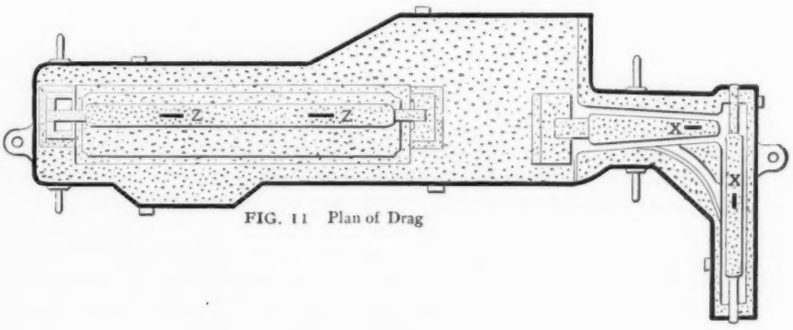


FIG. 11 Plan of Drag

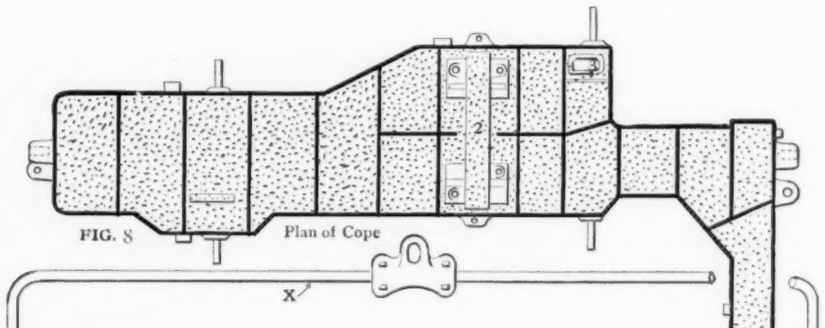


FIG. 8 Plan of Cope

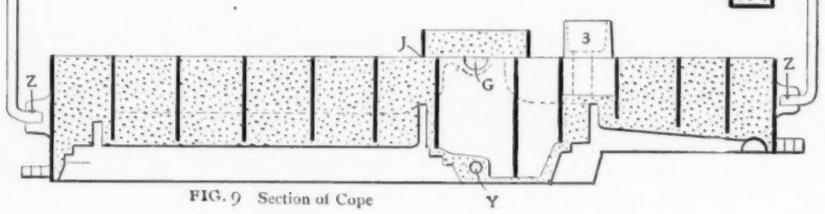


FIG. 9 Section of Cope

The mold is poured with a two-hundredweight shank at 3, Figs. 8 and 9.

RESULTS OF MACHINE MOLDING

The number of molds per day is twelve, at a labor cost of 10 pence each against 3 shillings 4 pence each from the loose pattern. The castings are about the same quality in appearance as when made by hand, but they are nearer duplicate than it was possible to obtain from loose patterns. This is in evidence every day in the machine shop, and some economies have been effected there, due to the easy and accurate fixing of the machine-molded castings into the various jigs, etc.

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Great Britain.

Education in Business Matters

Under the title "An Apprenticeship for Business Opportunity," the *Technology Quarterly* of the Massachusetts Institute of Technology for October publishes an article by I. W. Litchfield, a graduate of the institution, in which he advocates giving the students a responsible voice in the management of the institute. He points out that certain activities are already in the hands of student committees and claims that they are probably better managed than if the institute were responsible for them. Such activities have, he believes, the highest value in developing a sense of responsibility and he urges that large opportunities for extending this field of educational work exist in the formal administration of the material affairs of the institute.

At the Franklin Institute, Philadelphia, November 21, Edwin Swift Balch spoke on the subject of "the Survival of the Shortest and Easiest in Language." The address was a plea for the simplification of the spelling of many English words, especially those used extensively in commerce and for the adoption of the reform by the commercial and trade journals with the object of extending the use of English as the world's language of commerce.

SOME FIXTURES FOR FINISHING ARCS ON PARTS OF NAVAL GUN-SIGHTS

Twisted Jobs Where Great Accuracy is Required—How the Detrick & Harvey Company Solves the Problem

EDITORIAL CORRESPONDENCE

Among the private establishments engaged on the construction of various parts pertaining to naval ordnance is the Detrick & Harvey Machine Company, of Baltimore, Maryland, which has been making a considerable number of gun-sights, in which there are several parts which are, in shape, a long way from the "straight-line" class of job. The sights for the 6-inch naval guns include a piece known as the sight bar, which is shown in Fig. 2. The right-hand elevation in this illustration shows the piece approximately in the position it occupies when assembled on the gun. In a plane passing through the center line of the gun is pivoted a steel casting called a "yoke," the back end of which is carried by the head of the sight-bar (a yoke can be seen on the milling machine in Fig. 8). The yoke carries the sight telescope. The long curved shank of the sight bar (colloquially termed "sword") passes through a bracket on the gun slide (which last is the large casting having trunnions and embracing the gun, and through which the recoil of the gun upon firing causes the latter to slide); this portion of the sight bar is formed as a curved rack or segment of an internal spur gear, so as to permit of its being moved up and down by gearing in order to set the sight correctly for elevation of the gun. The sight bars for six-inch guns, illustrated in this article, are made together with the head as a solid steel forging. The head of the sight bar when assembled is at the left-hand side of the gun, quite a distance from the center line of the bore, and hence the oblique position which the head and the curved groove in it occupy with reference to the shank portion below. The curved groove in the head is to permit the horizontal movement of the yoke, which gives the azimuth adjustment of the sight.

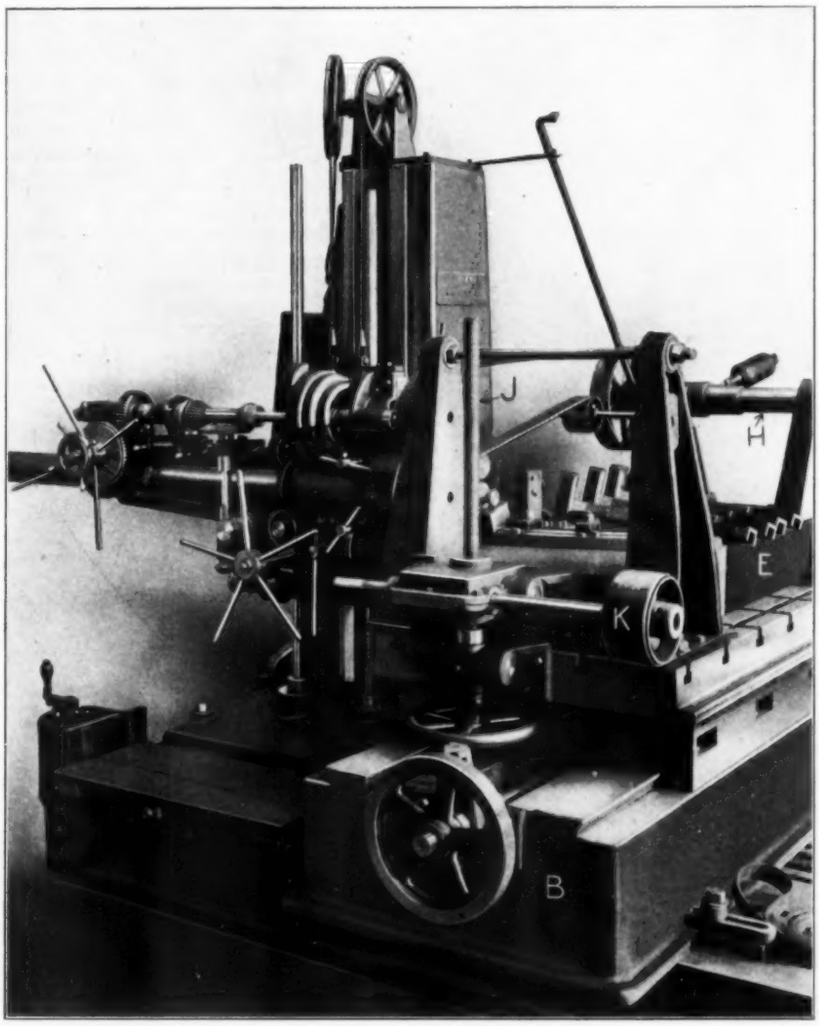


FIG. 1. MILLING AZIMUTH HEAD GROOVE IN SIGHT BAR, ON HORIZONTAL BORING, DRILLING AND MILLING MACHINE

ARC MILLING ON THE SIGHT-BAR HEAD

The milling of the curves on the sight-bar head was done by means of a Detrick & Harvey Standard 40-inch horizontal drilling, boring and milling machine by rigging it up as shown in Figs. 1, 3, 4 and 5. *A* (Fig. 5) is the platen or floor-plate of the machine; *B* is a bed bolted down to *A*; *C* is a bed dovetailed to *B* and sliding on it in a direction perpendicular to the axis of the spindle of the machine. The position of *C* with reference to *B* is controlled by an adjustable screw having on the end a wheel *F* graduated to read to thousandths of an inch. *D* is a platen bolted to the sliding bed *C*. *G* are bearing pedestals carrying a horizontal shaft *H* (Fig. 1), about the center line of which swings a tilting table *E*. The sight bar is placed on this table with its head overhanging, a guide on the table locating the bar properly. The tilting motion of the table is produced by a nut rotating on the screw *J*, the lower end of which is supported in trunnions to allow it to accommodate itself to the curved path of the nut. The nut is driven by a worm on a horizontal shaft having on its end a pulley *K*. The belt to *K* from the driving pulley on shaft *H* was not in place when the pictures were taken. It is evident that the table can, if desired, be tilted by hand by turning a hand wheel on the lower end of the screw *J* (see Fig. 1), thus turning the screw itself, the nut not turning because of the worm gearing. The method by which the shaft *H* is driven from a pulley on the horizontal milling machine and the arrangement of belt tightener and its counterweight are evident from the pictures.

The post and saddle of the machine were adjusted so as to fix the spindle at the proper place. The adjustment, to and from the work, of the cutter in the end of the spindle was obtained by the horizontal movement of the latter. The amount of cut was regulated by the adjustment of the wheel *F* governing the position of the sliding bed. The feed was given to the work by the revolving nut on the screw *J*, driven by belting and worm gearing already referred to. In Figs. 1, 3 and 5 may be seen a long rod projecting from a hub on the shaft *H*. This rod is provided for carrying a micrometer on its outer end with which to make accurate radial measurements of the curves on the head of the sight bar. The appearance of the sight bars can be well

gathered from the half-tone photographs, as, in addition to the one being machined, several of them appear in front of and lying on the machine. This method was found to give very satisfactory results.

ARC PLANING ON THE SIGHT-BAR SHANK

The planing of the curved surfaces of the shanks of the sight bars was done on a Detrick & Harvey 30-inch open-side planer, rigged up as shown in Fig. 6, which will be readily understood. To the bed of the planer was bolted a bracket carrying a vertical stud, about which swung the sector-shaped table carrying the work, the table being moved by the link in the background, which coupled it to the planer table. In the foreground are various jigs for holding curved pieces on the table, and to the right are more sight bars. The sector table has two holes for the stud, to provide for considerable variations in the radius desired, while the position of the stud itself in the bracket may be varied to bring the work to a convenient position on the machine.

ARC MILLING ON THE SIGHT-BAR SHANK

A similar rig was applied to a Becker-Brainard vertical milling machine for doing the milling of the curved surfaces of the shank. In Fig. 7 a rig of this kind is shown applied to a No. 6 Becker-Brainard vertical miller, the job in the picture, however, being the machining of the head of a sight bar for a five-inch gun, mark XIII, modifications 2 and 3. In the case of these latter sight bars, the head was made separate from the shank. Several other pieces of work are shown piled up on the machine. The sector table of this rig is provided with a slot, instead of holes, for the stud, giving a greater number of positions for the latter.

ARC MILLING ON A YOKE

Fig. 8 shows the milling on a Becker-Brainard vertical miller of the cast-steel yoke for a six-inch sight, mark XIX. The portion upon which the cutter is working is that which fits the head of the sight bar already described, and the yoke is, of course, swung about its pivot hole through which the stud passes. The scale lying on the machine is a foot long.

H. J. K.

The Daimler Company, of England, shows by its statement that it has made during the past fiscal year about $1000 net profit on each automobile it has turned out, the number of cars being 1000; so that it has done a pretty good business. It is otherwise evident that very large profits are being made by some manufacturers in the automobile line; but in many cases this profit is being reaped after a long series of years during which the business was anything but profitable and during which in fact very much money has been spent without returns. The profits now being made will, however, inevitably tempt additional capital into the business with the expectation of making like profits, which expectation will be disappointed in most cases, but will result in the lowering of prices probably.

United States Attorney-General Moody proposes as a method for curbing the trusts, the publication of the names of all stockholders in corporations. We have our doubts as to the efficacy of that method, but in an interview regarding it, Mr. Moody makes a statement which we consider to be decidedly refreshing. He was asked to tell about the best day's work he had ever done, and in his reply, said he thought the argument made by him in the Supreme Court in the peonage cases was his best day's work, and said he in this connection: "There is more in human liberty than in any other question which concerns mankind."

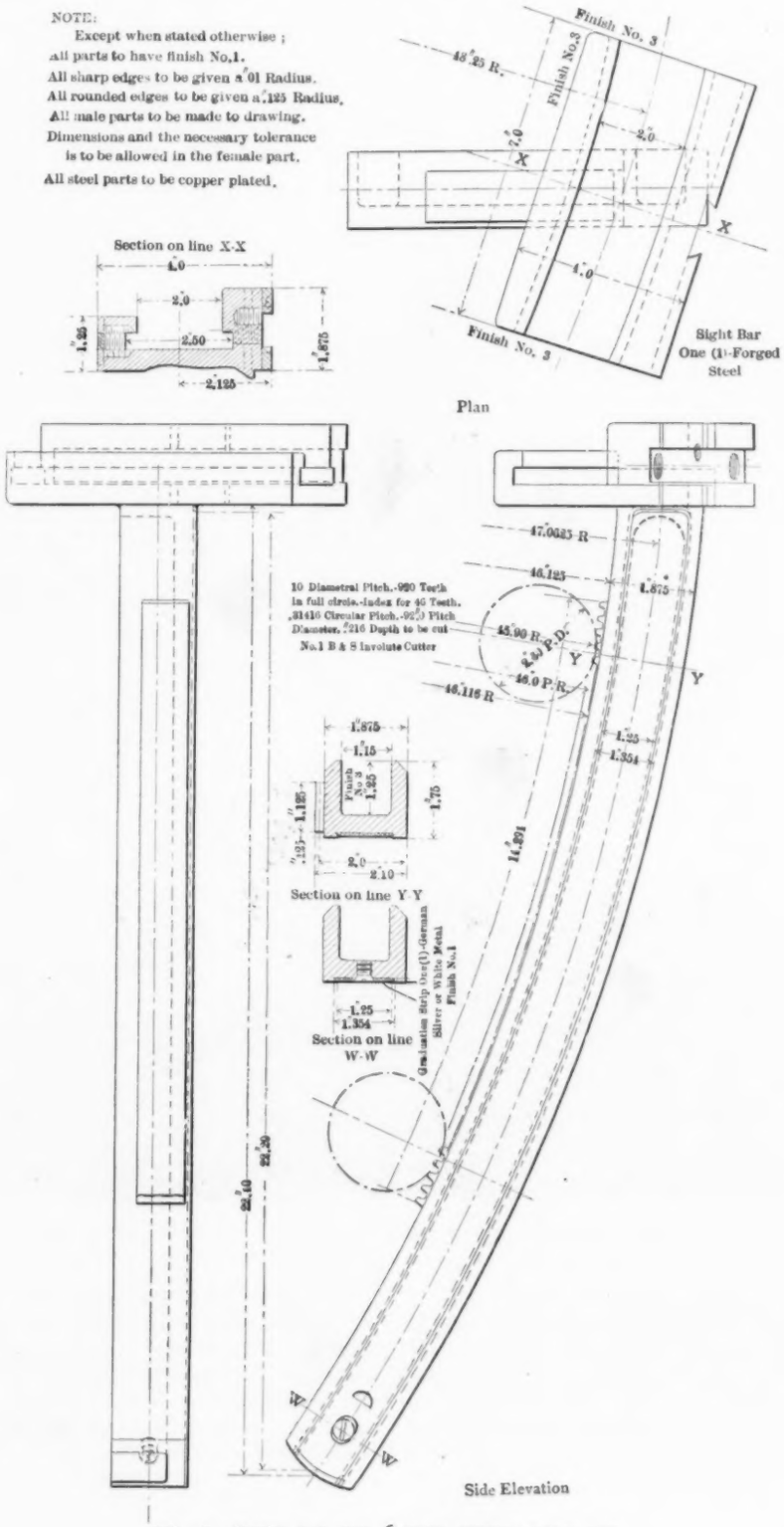

NOTE:
Except when stated otherwise;
All parts to have finish No. 1.
All sharp edges to be given a .01 Radius.
All rounded edges to be given a .125 Radius.
All male parts to be made to drawing.
Dimensions and the necessary tolerance is to be allowed in the female part.
All steel parts to be copper plated.
Section on line X-X
Finish No. 3
Sight Bar One (1)-Forged Steel
Plan
10 Diametral Pitch, 990 Teeth in full circle, Index for 45 Teeth, .3141 Circular Pitch, .9270 Pitch Diameter, .7216 Depth to be cut No. 1 B & S Involute Cutter
Section on line Y-Y
Graduation Strip One (1)-German Silver or White Metal Finish No. 1
Section on line W-W
Side Elevation

FIG. 2. SIGHT BAR FOR 6-INCH SIGHT, MARK XIX

The Scrap Manufacturing Company—System and the Lack of It—The Large vs. Small Factory

BY MICHAEL MAC MICHAEL

The editor, and he knows, says that it is the AMERICAN MACHINIST because it caters to the man who is interested in machines and that such a man is a machinist. Funny, isn't it, that nearly every one is a machinist—"Entropy," and the Oiler and all of us, for we certainly are a various and motley collection. Yet in this one interest, that of machines, we are blood brothers, and whether we are making coal crushers or watches, we have common interests, common troubles, and common remedies for our troubles. I am one tooth in a ten thousand-tooth train, and I don't move in the original driving pinion either; and yet the troubles of the man in the ten-man shop are mine, except that mine are greater and harder to remedy and localize. Also the human beings in the ten-thousand-man plant have the some methods of locomotion, assimilation, thought and general cussedness that are found in the job shop; but in the job shop everyone knows who is responsible for cussedness, while in a big plant it keeps us guessing to tell whom to have fired.

And so, while I have been reading the "Echoes from the Oil Country," I have been hoping that some of the servants of

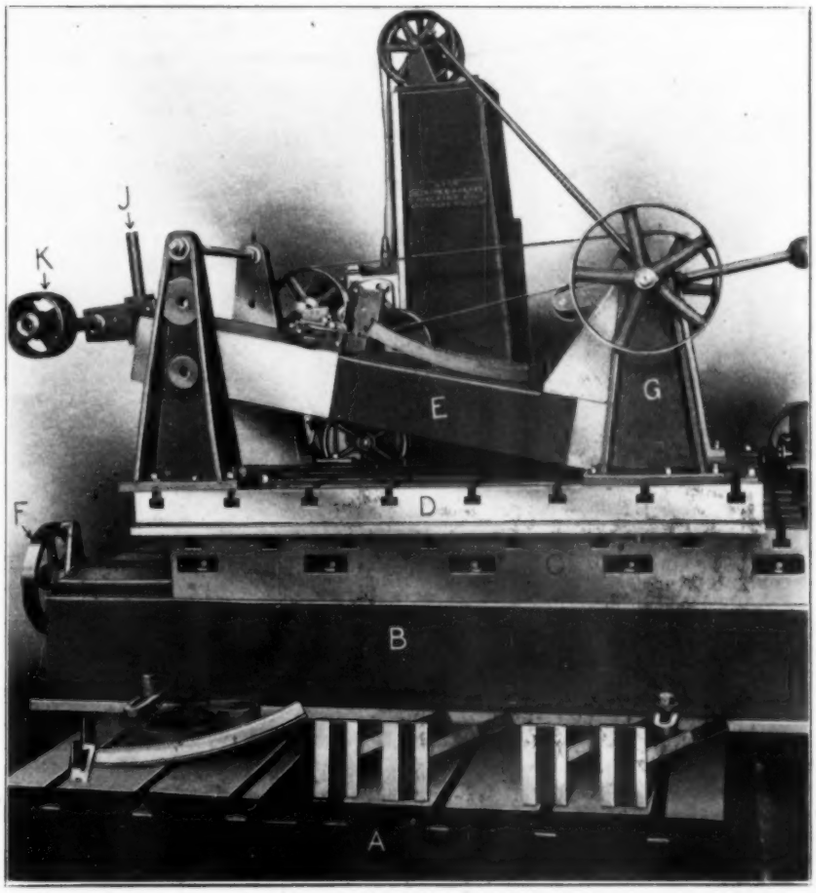


FIG. 5. END OF THE CUT

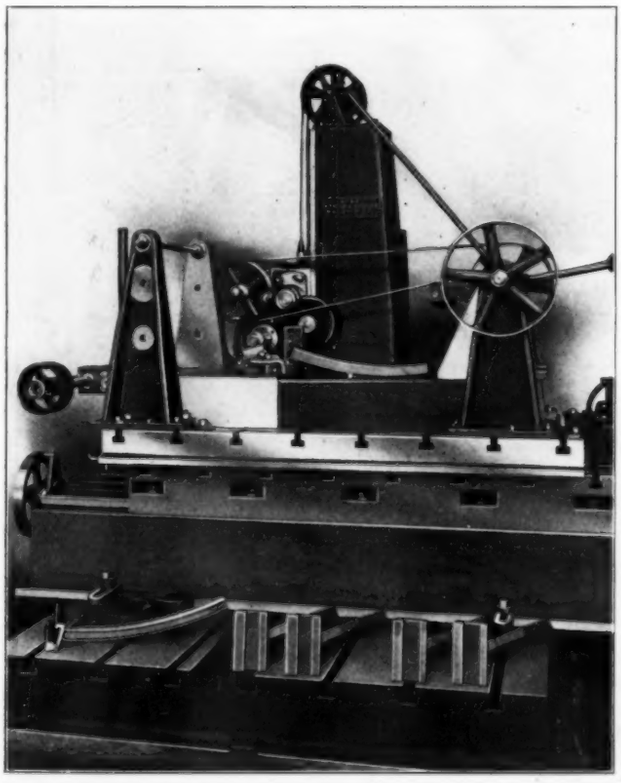


FIG. 3

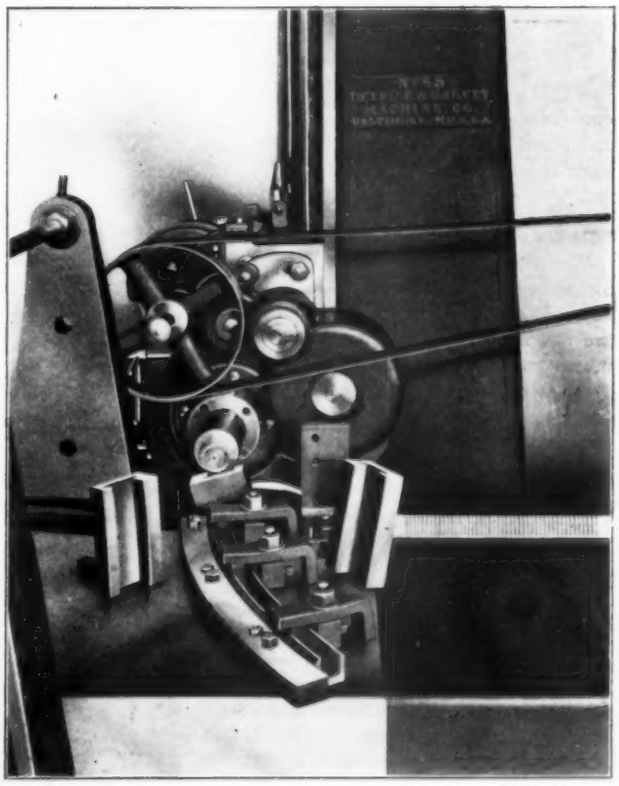


FIG. 4

STARTING A CUT

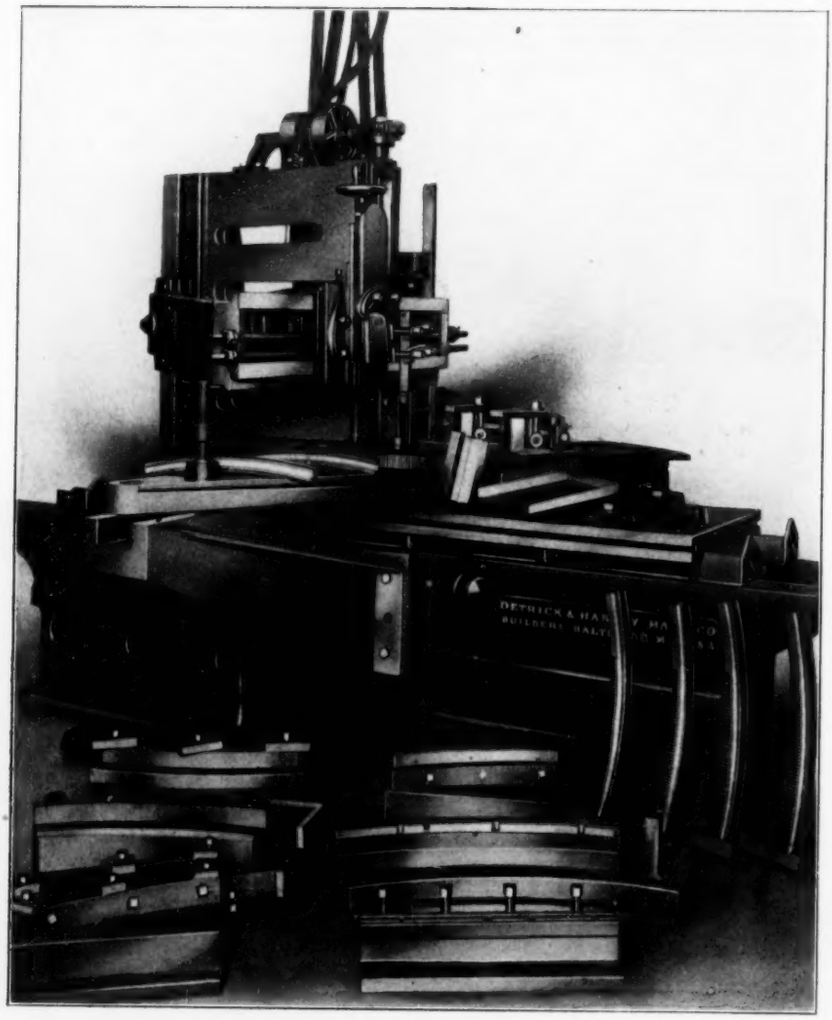


FIG. 6. RIG FOR DOING THE ARC PLANING ON SHANK OF SIGHT BAR

our great corporations would dip in and tell about their troubles, because we all have them. However, as no one has, as yet, done so, perhaps I can start the ball.

SYSTEM IN THE BIG SHOP

We of the big shops are cursed and blessed with system; we are like the small boy, not happy till we get it, and then we are not happy. We want it, and having it, we hunt ways to evade it. We can't get along without it, and every time we try to get anything done we find we can't get along with it. It is a great and necessary burden, and as one gets older, and has more experience with human nature, he realizes that no system that does not take into account the innate selfishness of human nature will succeed.

SELFISHNESS AND SYSTEM

To illustrate: We found that certain classes of works should have preference, and invented three classes of tag; red for immediate, yellow for ordinary customer's stuff, and green for our own stock. It was supposed that everyone sending material through would classify it. And so they did. Everything was red, for everyone wanted his work done at once; and nearly everyone could give good reasons why his work should be pushed. The system was therefore no good, as it left it to the man to say how much of a hurry he was in, and no one would wait. The shop soon became so cumbered with red tags that the shrewd foreman stuck on a green tag, and found that it really got the preference, as all were so sick of the red tag that they wilfully ignored it.

BLUE-PRINTS DESTROYED BECAUSE MIS-SENT

Take another case of selfishness. We often send drawings through our mail system to the wrong part of the shop. The shop clerk who receives them invariably scraps them, although perhaps some fellow in the next office is holding important work for that drawing. The way the clerk figures is this: They are not his; he doesn't want them, and he is not going to bother to send them back. The print itself only costs a few cents, but we lose two days' time, perhaps, on a $10,000 job because someone is selfish.

RESULTS OF LACK OF SYSTEM CHARGED TO SYSTEM

Another case is in the office on our documents and drawings. We put in our cards to filing vault through the mail and documents are delivered by messenger. If the document is not in, we refer to the index, and see whose card is in for it. As there is a vast volume of business, we then send a boy after the document. Now here is where the selfishness comes in. The man to whom it is charged does not care whether the boy gets it or not. If he has it, and doesn't want it, he gives it

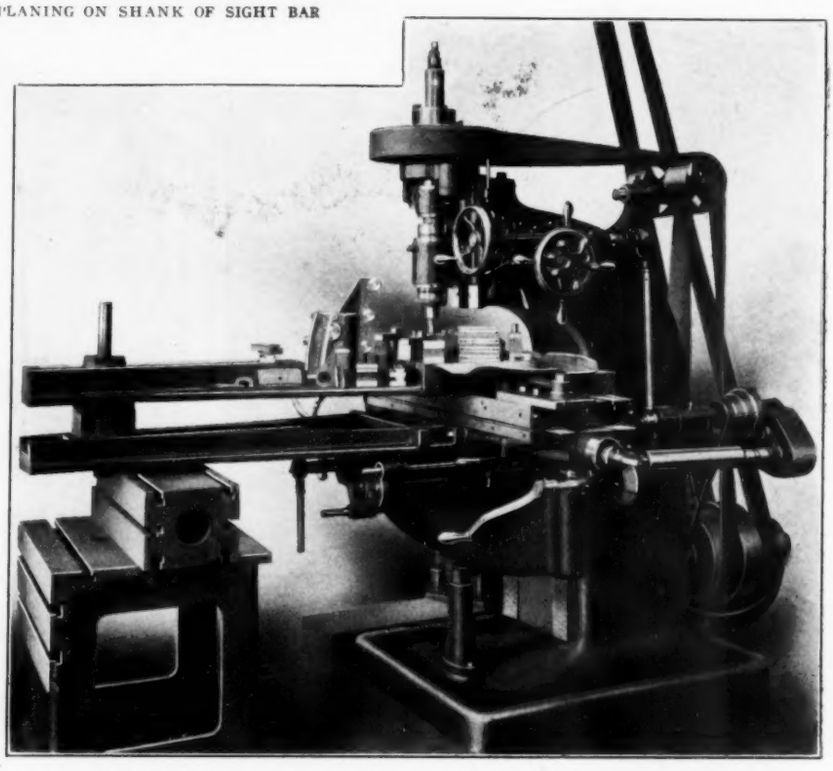


FIG. 7. MILLING CURVED GROOVE IN SIGHT-BAR HEAD FOR 5-INCH SIGHT, MARK XIII

up; but if he does not have it, he simply says he sent it back. Nine times out of ten he has loaned it to someone, or has it stowed away somewhere among his papers. And yet that same man will be the first to cry aloud when he asks for a document, and it does not come. Selfishness is our great evil, and the place is so large, and cause and effect are so widely separated that no one realizes what an evil it is.

FORCES OF CONCENTRATION AND OF DISSOLUTION

In every business in this country today there are two forces at work; one a force tending to make great corporations; plants covering acres of ground, and with thousands of employees; the other a force tending to keep sizes down, to make small factories, each self contained and ruled by one strong man. The greater the business, the more cumbersome the system, the more clerks we need to check each other, the more waste in time and material due to misdirected efforts. Against this, set the production of duplicate parts in thousand lots, the specialization of men and tools, and the prestige of a great organization.

GIRLS TO MAKE TRACINGS

In every great corporation these forces are working. Take for example our tracings. We employ girls to make our tracings and they copy with great neatness and speed the original work of the draftsmen. These girls can make two tracings a day and in cost we can probably compare favorably with any other place where such work is done. But we must set against this the fact that we cannot use our tracing department as a training school for draftsmen, as only the older girls understand that a hex nut is not in any way related to salted almonds or other tree varieties. Here we have the force that makes women tracers unadvisable.

EXPENSE OF GETTING THINGS TOGETHER

In our shop we try to manufacture screw-machine parts in one department, punchings in another, and forgings in another. We save on the individual parts thereby, but when we come to count in labor and system to get all these parts together into a complete automobile we find that much of this saving disappears. Also it is slow. If a man in the finishing department wants a small piece he must requisition and beg to get it and he spends more time and money than would make a hundred pieces if his department had facilities for doing the work.

STOCK KEEPING

Then another thing that is against a great corporation is the raw-material question; the question of stores, of always having steel to work and iron to cast, the problem of keeping enough machine screws in stock, of seeing that enough sheet rubber is in place for gaskets. You cannot keep a fortune tied up in useless stock. You cannot afford to have some change in conditions leave on your hands 100,000 ¼-inch 20-thread by ⅜-inch machine screws that no one wants, and yet you must have enough. In a small shop with one line of manufacturing one man can manage. In a big shop no one can manage. Our purchasing department can buy as cheaply as the cheapest and yet this is offset by the constant waste and deterioration of that stock when bought.

THE SALESMEN

Take our sales department. When we had one salesman he happened into the factory every few weeks and spent a day or two. He knew what we had in stock and what we could do on deliveries and prices. We now have hundreds of salesmen. Most of them know where the factory is. All of 'em have price lists and catalogs. We can make some of their deliveries, and they do sell, at times, cars that we have in stock and yet mostly we neither of us do these things.

SMALL VS. LARGE SHOPS

You hear a lot these days about the decline of the small manufacturer and the reason mostly given is that the big concerns can manufacture so much cheaper. And yet I doubt it. It is more that our laws and system favor the big fellow. Personally I believe I could manufacture in a small shop cheaper than we can in our big one. However, I could not buy material or sell product or even ship it without being gouged by some monopoly. If I made money the trust would systematically ruin me and if I did not I would ruin myself.

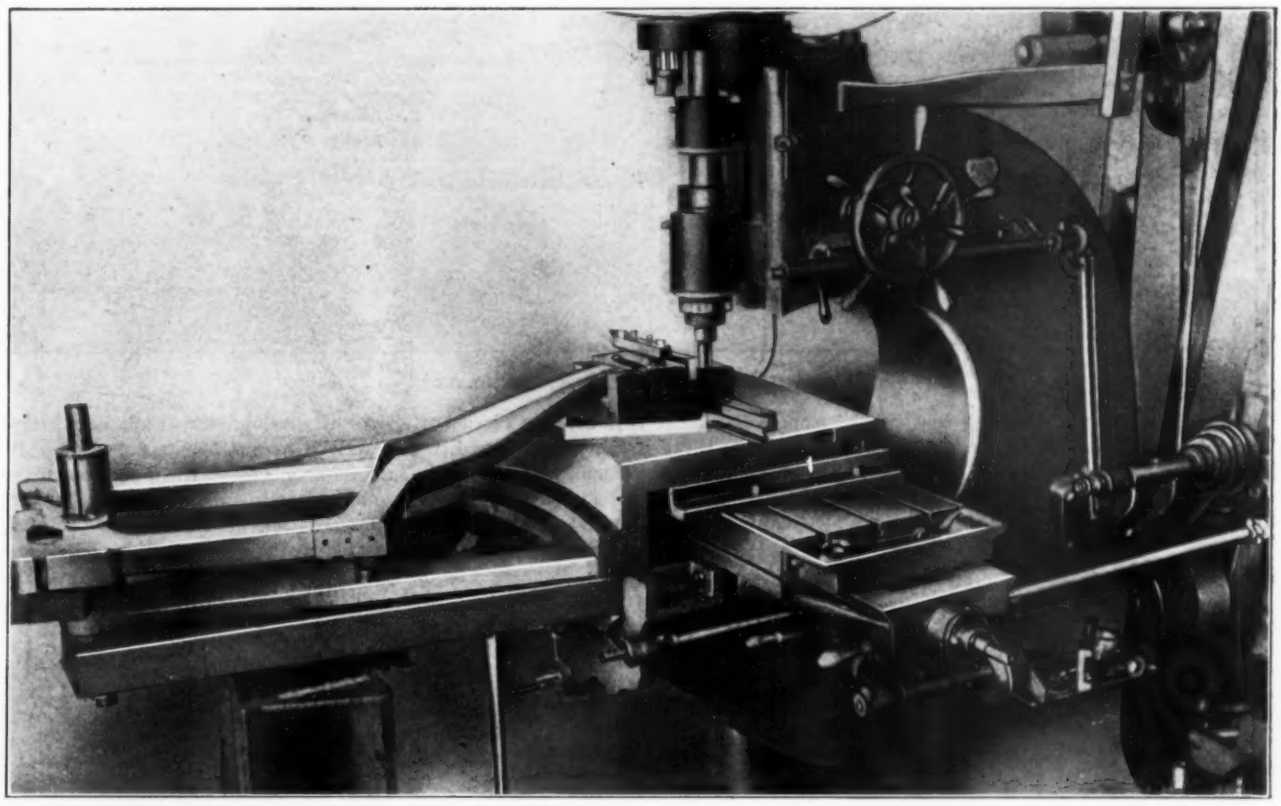


FIG. 8. MILLING THE ARCS ON A YOKE FOR A SIX-INCH SIGHT

It is like the Irishman who said that starvation was staring him in the face, whereupon his listener made the pat remark that it could not be pleasant for either of them.

Manganese in Manganese-Bronze

A recent controversy has arisen between a manganese-bronze producer and a manufacturer in regard to the term manganese-bronze. The manufacturer found no manganese in the manganese-bronze that was sent to him, hence he considered that the metal was not manganese-bronze.

To the uninitiated, such a supposition is quite natural. If a manufacturer rereceived a shipment of tin-plate without any tin, he certainly would not accept it. He would also expect a graphite crucible to contain graphite. It is not a matter of surprise, then, that those who are unfamiliar with alloys should expect to find manganese as an ingredient of manganese-bronze. If it has unsatisfactory properties and is free from manganese, then it is assumed that the absence of the manganese is the cause of it.

It should be noted as a well established fact, that manganese-bronze may be of excellent quality and yet contain no manganese at all. As a usual rule, commercial manganese-bronze ingot contains a very small quantity of manganese, but when melted over once or twice, it oxidizes and disappears.

The object of adding manganese to manganese-bronze is to act as a carrier of iron. Iron is the strengthening ingredient of manganese-bronze and without it the metal would not be satisfactory. It is impossible, however, to introduce the iron directly as it will not alloy with the copper. By first alloying the manganese with the iron, the iron will all chemically combine with the copper. The only function of the manganese, then, is to act as a carrier of the iron into the copper. The small amount of manganese that is added for this purpose is oxidized out in a few meltings so that not the slightest trace can be found in the bronze.—*The Brass World.*

The matter of prepaid foreign postage continues to be discussed, and the latest method of avoiding trouble with it is published in the Daily Consular Reports, and comes from Montgomery, Ward & Company, of Chicago. They use the method of varying sizes of envelops, which has been already described in our columns, and they furthermore inclose in their envelop to their foreign correspondent, where an answer is expected, an envelop with a notice printed in the upper right-hand corner as follows: Postage from British countries 2½d. (5 cents).

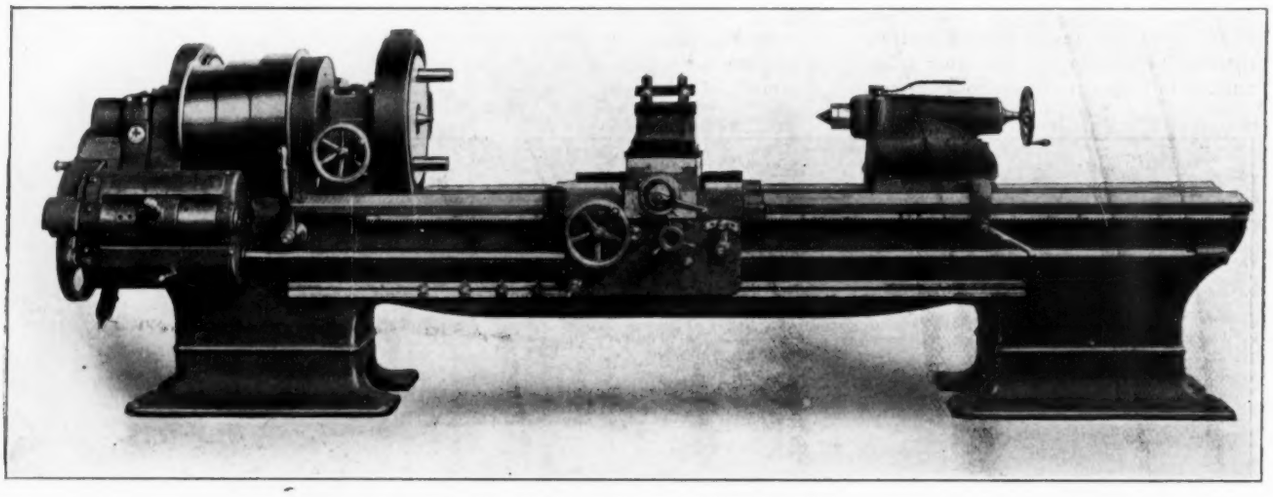
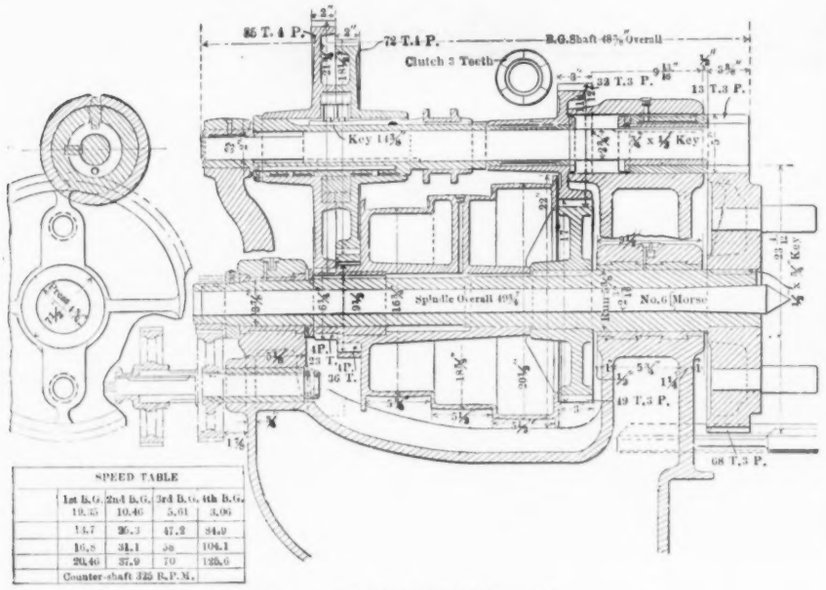


FIG. 1. GENERAL VIEW OF REDUCING LATHE



SPEED TABLE

	1st B.G.	2nd B.G.	3rd B.G.	4th B.G.
	19.35	10.46	5.61	3.06
	14.7	26.3	47.2	84.9
	10.8	34.1	58	108.1
	20.40	37.9	70	125.0

Counter-shaft 325 R.P.M.

FIG. 2. SECTION THROUGH HEAD

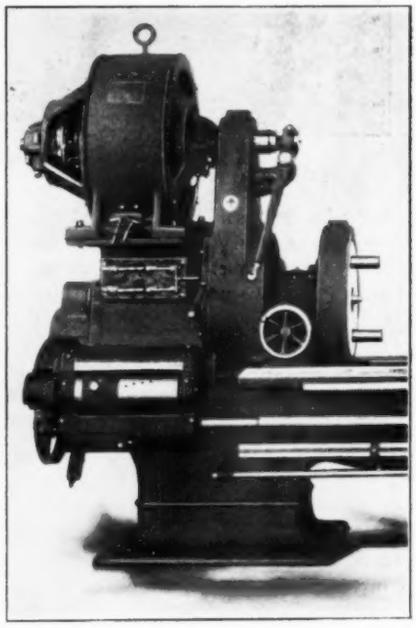


FIG. 4. MOTOR-DRIVEN HEAD

High-Speed Reducing Lathe

The engravings illustrate a lathe specially designed for taking heavy cuts on steel bars and forgings, and known by its makers (the R. K. Le Blond Machine Tool Company, Cincinnati, Ohio) as their 10-inch high-speed reducing lathe. It actually swings, however, 25¼ inches over the shears and 17 inches over the carriage. In fact, when so desired, the lathe may be equipped with compound rest and screw-cutting mechanism and is then available as an extra heavy 24-inch lathe. When so constructed the cone and gear ratios are proportioned to give the proper range of speeds for a lathe of this swing, or these speeds may be arranged to suit any special class of work. A similar type of machine has been built for several years by this company, but the present lathe has been entirely re-designed to double its former capacity and is practically a new tool throughout.

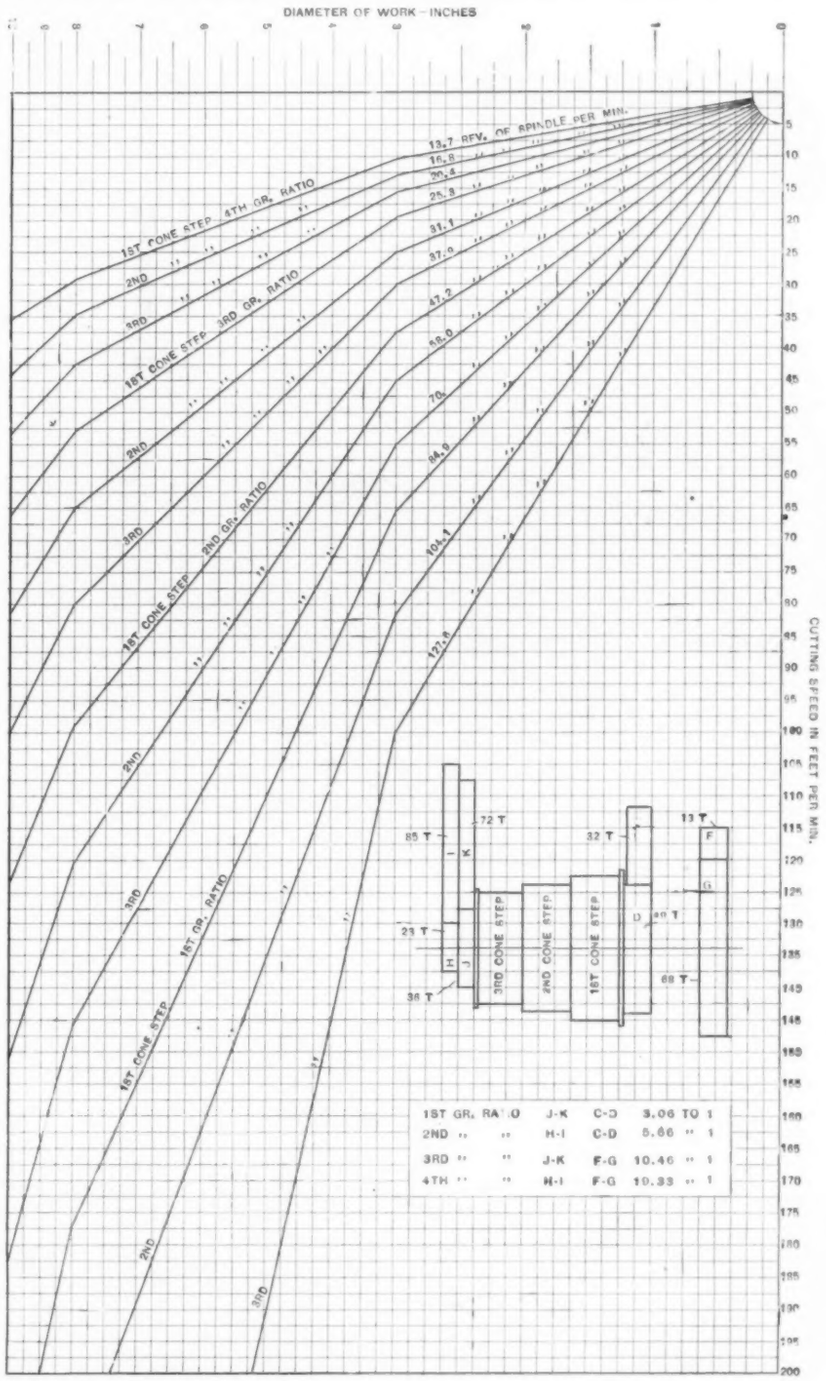


FIG. 3. CUTTING-SPEED DIAGRAM

THE HEADSTOCK

As will be seen from the general view, Fig. 1, the headstock of this lathe is cast integrally with the bed; this construction giving rigidity and accommodating the large cone diameters which range from 16¾ to 20½ inches. There are twelve changes of speed for the spindle with the three-step cone and single-speed countershaft and these speeds are arranged in geometrical progression with practically an even increase of 22½ per cent., the error being less than 2 per cent. in all cases, and the speed range being from 13.7 to 127.6 revolutions per minute.

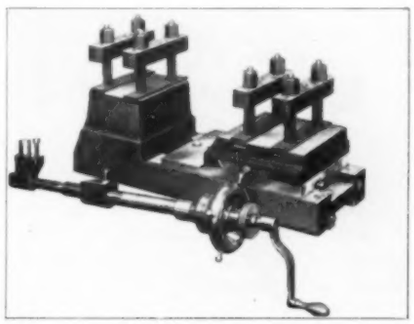


FIG. 5. ROUGHING RESTS FOR CARRIAGE

The arrangement of gearing, shown clearly in the sectional view of the head in Fig. 2, gives four ratios between cone pulley and spindle, these ratios being respectively 3.06, 5.66, 10.46 and 19.33 to 1.

CONTROL OF SPEEDS

The speed changes through this gearing are made by means of the lever and hand wheel seen in Fig. 1. The lever starts and stops the spindle and engages either of the friction back gears. The hand wheel controls a clutch and a sliding gear engaging either the high- or low-ratio face gear.

The cone speeds are, maximum, 398, and minimum, 265 revolutions per minute. With the gear construction shown, larger cone steps and increased belt velocity are obtained, and assuming a belt pull of 50 pounds per inch in width (the width of belt being 5½ inches) it is computed that the lathe should deliver a maximum of 15 horse-power and a minimum of 12 horse-power.

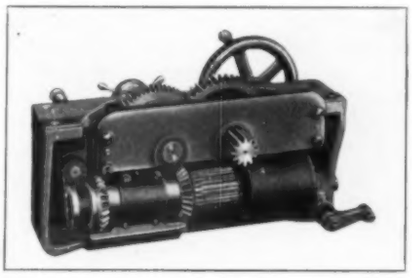


FIG. 7. INTERIOR OF APRON

A cutting-speed diagram for this lathe is shown in Fig. 3, which also includes a diagram of the driving cone and gearing, with the ratios of the latter.

MOTOR DRIVE

Motor drive can be applied to the head, as illustrated in Fig. 4. The drive from the motor is by means of a Morse chain

of 4-inch face, and sprocket gears of 4.7 to 1 ratio. Four mechanical changes are obtained through gears, the maximum ratio between motor and spindle speeds being about 61.1 to 1 and the minimum, 10.4 to 1. The motor shown is a 15 horsepower variable-speed affair with a speed range from 500 to 1500 revolutions per minute providing for any desired spindle speed from 8 to 144 turns per minute. The motor gear is provided with a friction clutch which is controlled by a long lever extending down within easy reach of the operator, and the lathe may be stopped and started again without stopping and starting the motor. The motor speeds are controlled by means of a crank handle mounted at the side of the lathe carriage.

THE CARRIAGE

The carriage is provided with double roughing rests, shown in Figs. 5 and 6. The slides for the tools are here balanced, that is, the rear slide is extended nearly to the front of the carriage and dovetailed to receive the front slide, so that tendency on the part of the rear tool to lift its slide from the carriage is offset by the pressure downward of the front tool. The front slide has cross adjustment, as indicated, so that the tools may be set to divide the cut. The slides may be operated independently or together by the double screw whose construction is clearly shown in the drawing. After the slides are set to suit the cut, they can be locked together by the friction knob on the hand wheel.

THE APRON

The apron is shown from the rear, in Fig. 7. It will be seen to be of semi-box construction and all shafts and studs as there represented are well supported at both ends. The gears are of steel in each instance.

THE FEED GEAR

The feeds for the carriages are obtained by the well known quick-change mechanism used on other lathes of the same make. Thirty-two changes, ranging from 0.024 to 0.348 inch per turn of spindle, are provided for as shown in Fig. 8. These

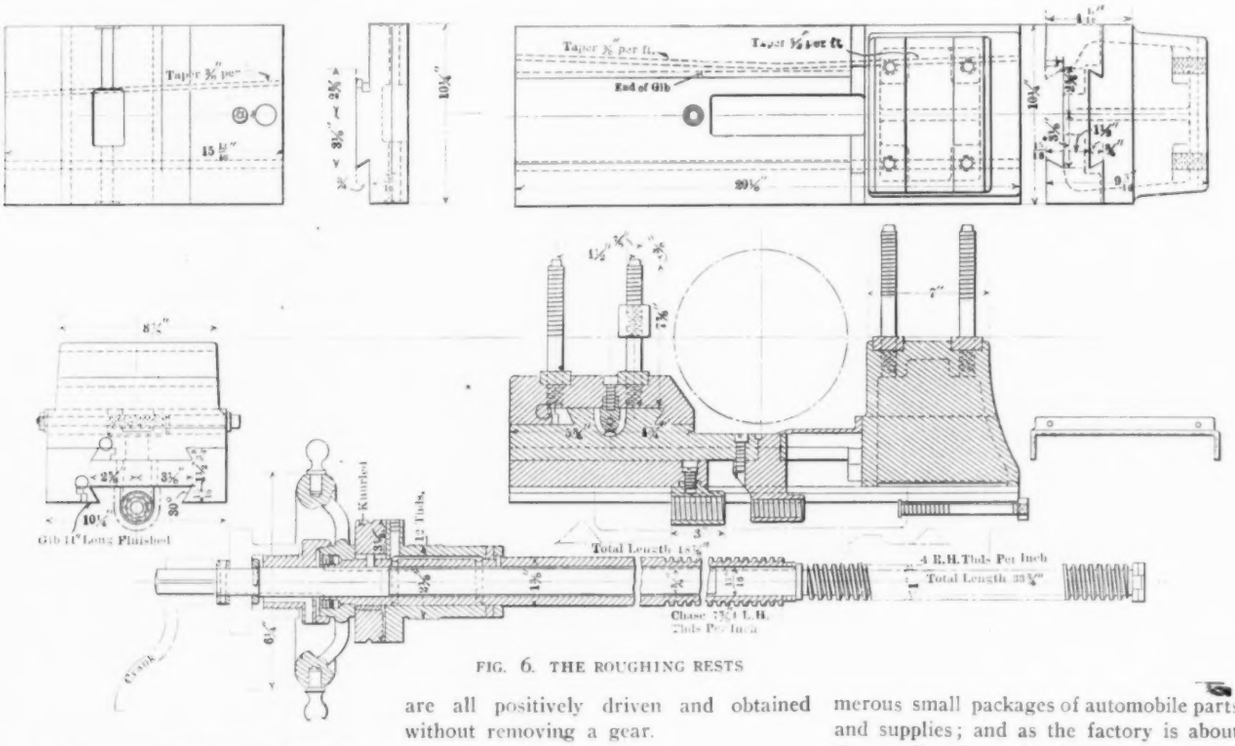


FIG. 6. THE ROUGHING RESTS

are all positively driven and obtained without removing a gear.

GENERAL DATA

Some dimensions not given in the foregoing description may be of interest: The spindle has a front bearing 5⅜ inches diameter by 9½ inches long; the rear bearing is 3⅞ inches diameter by 6 inches in length. The hole through the spindle is 2 3/16 inches diameter and the center is Morse No. 6 taper. The bed of the lathe shown is 10 feet in length. The countershaft pulleys are 20 inches diameter for a 6-inch belt and the speed of the counter is 325 revolutions per minute.

The R.K. LeBlond M.T.Co.	Feeds per Rev of Spindle									Cincinnati, O., U.S.A.
Telescope Gear In	.188	.197	.206	.226	.251	.283	.323	.348	→ Lever ←	U.S.Patents 584091 652786 706186
	.091	.098	.103	.113	.126	.141	.162	.174		
Telescope Gear Out	.047	.049	.051	.057	.063	.071	.081	.087	→ Lever ←	725099 763778 763912
	.024	.025	.026	.028	.031	.035	.040	.043		
	↓	↓	↓	↓	↓	↓	↓	↓	↓	

FIG. 8. THE FEED PLATE

A Case where the Automobile has Displaced Horses with Great Advantage

We have several times referred to the promising field for the application of the automobile to the replacing of the horse in local transportation of goods; recently we have been informed of an instance where economical results were thus obtained, even without the acquisition of a vehicle designed for the carriage of freight. It was the conversion to this service by an automobile manufactory in Cleveland of an old demonstration car. The concern, the Royal Motor Car Company, receives at intermittent periods numerous small packages of automobile parts and supplies; and as the factory is about three miles from the freight depots, the making a number of trips for small loads was a pretty expensive teaming proposition, sometimes an entire day being spent by team and driver in making four or five trips, and hauling only a few hundred pounds weight of material. The solution of the difficulty evidently required a fast traveling vehicle, so the body of an old four-cylinder automobile was removed and a box fixed on the chassis, and a colored man taught to run it. Though the crudity of the affair excited gibes and sneers, the experiment was so successful that the rig has been in use for two years, carrying nearly 50 per cent. of the material for the construction of the product of the factory, at less than one-half the cost of horse-drawn drays. It is always ready for business, and makes ten times as many trips as were formerly possible.

An Automatic Pipe-bending Machine

Fig. 1 is a general view of a machine designed to bend pipe into various shapes, such as U and S bends, return coils, etc., without filling. It will bend 1- and 1¼-inch pipe any radius from 2½ to 12 inches; 1½-inch pipe from 3 to 12 inches radius; 2-inch pipe from 4 to 12 inches radius; 2½-inch pipe 6 to 12 inches radius.

The table is 61x32 inches, supported as shown on four legs, having braces between them which support the main driving and worm shafts. Between the braces is a bridge piece which supports the vertical shaft carrying the worm gear near its lower end. The vertical shaft projects through the table and carries at its upper end the forming roll and clamping device for holding the pipe while being bent. To the right in Fig. 1 are shown the two pressure rolls on top of the table. These are advanced or withdrawn by means of a screw operated by the hand wheel shown to the right.

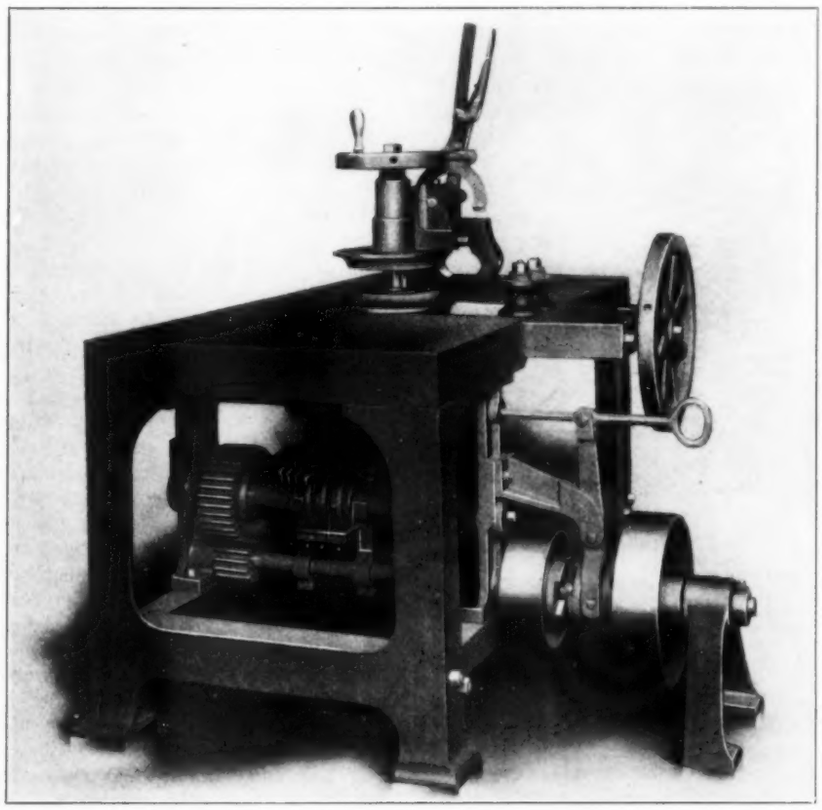
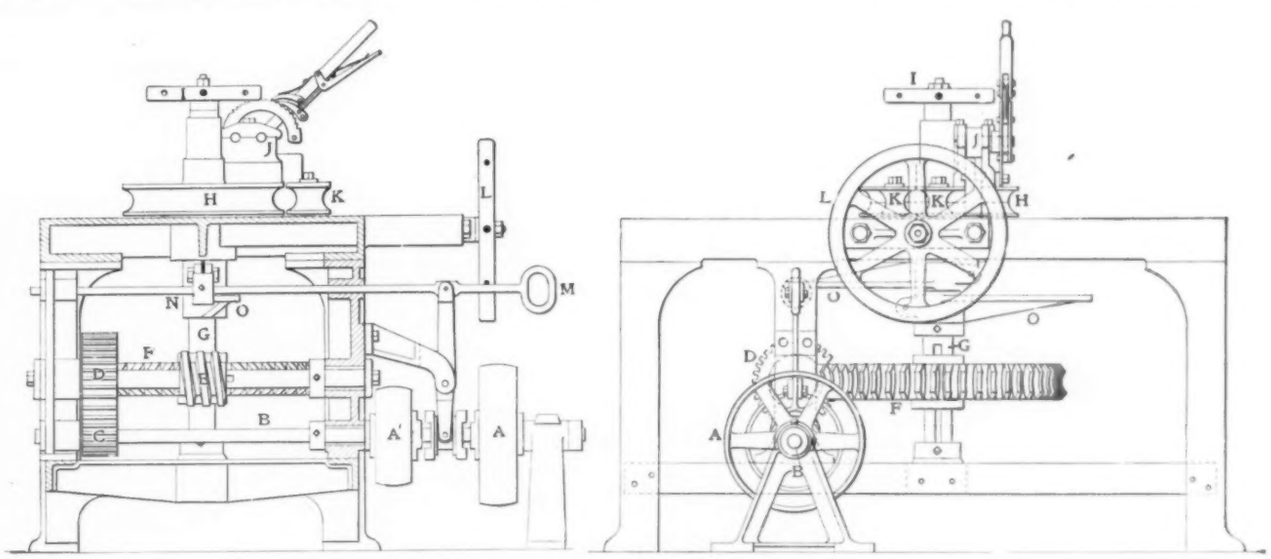


FIG. 1. AN AUTOMATIC PIPE-BENDING MACHINE

Figs. 2 and 3 show the machine in section and side elevation. The driving pulley *A* and the small quick-return pulley *A'* are mounted on the driving shaft *B* with a clutch between them. At the other end of *B* is the pinion *C*, which engages the spur gear *D* mounted on the worm shaft. The worm *E* on this shaft engages the wormwheel *F* mounted on the vertical shaft *G*. The forming roller *H* is in two parts. The upper part of *H* is splined to the shaft *G* and may be raised and lowered by means of a screw actuated by the hand wheel *I*. The clamp *J* is secured to the forming roll *H* and revolves with it. The clamp *J* is more fully shown in Fig. 4. The pressure rollers which bear against the pipe are shown at *K*. They are attached to a slide actuated by the hand wheel *L*. On the vertical shaft *G* are two levers *O*. These are adjustable and control the amount of bend given to the pipe, for when they come in contact with the collar *N* on the shifter rod *M* the clutch is thrown out of engagement with the pulley *A* or *A'*, whichever happens to be in engagement at the time. In this way the traverse of the forming roll may be set so as to produce uniform bends in any quantity.

Fig. 4 shows the details of the forming roll to the left and the clamping mechanism to the right. The line cut shows plainly how the upper half *A* of the forming roll is raised and lowered by the screw. The pipe clamps *F* and *F*¹ are opened and closed by the two racks operated by the two pinions as shown. The lever *D* and ratchet quadrant *E* provide an easy means of operating and a simple and secure lock for the clamp.

Referring to Figs. 2 and 3, the method of operating the machine is as follows: The pressure rollers *K* are drawn away from the forming roll *H*. The clamping lever is thrown up into a vertical position, which opens the pipe clamp *J*. The upper part of the forming roll *H* is raised about



FIGS. 2 AND 3. CROSS SECTION AND SIDE ELEVATION OF PIPE BENDER

½ inch. This permits the pipe to be readily entered in the machine. The pipe is entered and located at the proper position for the bend. The upper half of the forming roller *H* is then screwed down tight; the lever of the clamp *J* is pulled forward so that the clamp grasps the pipe; the pressure rollers *K* are forced against the pipe and the machine is started. The tripping arms *O* having been set at the desired points, the machine runs till the trip *N* operates, throws the clutch out and the machine stops.

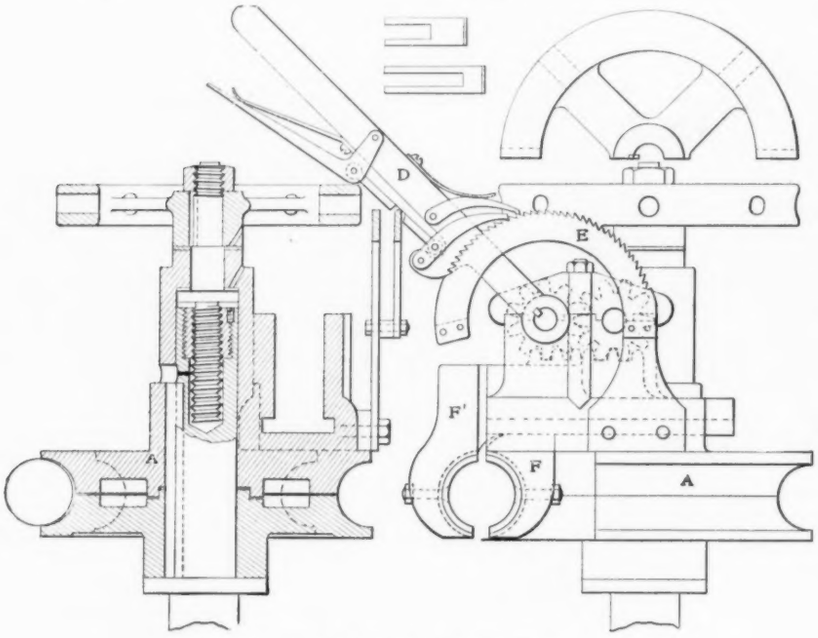


FIG. 4. DETAILS OF FORMING HEAD

This machine was invented by Jacob Neuert, of Chicago, Ill. It is built by the Stoever Foundry and Manufacturing Company, Myerstown, Lebanon county, Penn.

A rubber substitute patented by William Threlfall Carr, a Lancashire man, is made by treating any cereal with an organic chemical termed ptyalin —practically the essential ingredient in the saliva of animals. This acts as a ferment, and turns the starchy matter in the grain into dextrose. After the grain has been treated and worked up in a kind of a motor-mill, another chemical is added, which stops any further action of the fermentive. The substance is fixed in certain strengths—a thin liquid solution for waterproofing, a thicker solution for tubes and other flexible articles, and further hardened and loaded for various industrial purposes. It is to be hoped that the new substitute will realize expectations, for dear rubber is seriously hampering the electrical and other industries, while its price is continually increasing with the demand for it, and any substitute that could be used for electrical work and rubber tires would bring down the existing prices considerably.—*The Indian Electric, Mechanical and Textile News.*

GRADUATING RANGE STRIPS

A Method of Making Irregular Graduations

BY J. J. STRONG

In a previous article I described a machine for graduating the range dials of the sights for navy guns. The machine used to graduate the strips of the same sights is equally interesting.

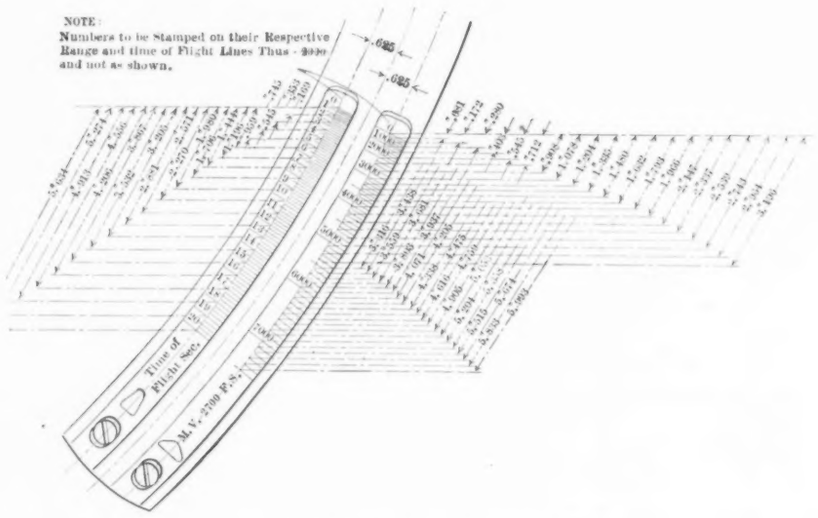

NOTE:
Numbers to be Stamped on their Respective Range and time of Flight Lines Thus - 2000 and not as shown.
.085
.085
Time of Flight Sect.
M. V. 2700 F.S.

FIG. 1. THE STRIPS TO BE GRADUATED

Fig. 1 shows a set for the 3-inch sights M K VII. including the time of flight and the range strips. All sights have strips similar to these. Fig. 2 shows a top view of the machine with a set of strips in position to be operated upon.

DESCRIPTION OF THE MACHINE

The machine is about 14x20 inches over all. The bed plate is of steel with T slots milled in for clamping the slides on which the strip carriage travels and to allow for the difference in the radii of the slides used. One sight may have a straight strip as in Fig. 3 and no two have the same radius.

The tool carriage is operated by the lever and is elevated on a slide so that it clears the strip carriage by about ⅛ of an inch. The screw on the top of the carriage is for adjusting the depth of cut, and the one in front for locking the tool after it is set. The tool is circular and shaped like a threading tool. The tool holder is reversible, allowing for cutting from either side of the strip, and has a relief on the return stroke. A spring at the rear of the tool carriage acts on a ratchet wheel of the stops, locking it in position. The stops are shown in Fig. 4 and are secured on the side of the tool carriage. On each movement of the lever the stop is rotated by means of a pawl that engages the ratchet and brings up against permanent stops at the end of the stroke. One of these stops is shown at the extreme farther side of the machine, the other being covered by the lever.

Fig. 4 shows how these stops govern the length of the lines, No. 1 being for the range strip shown in the machine and giving three lengths of lines and ten divisions. Each tooth of the ratchet represents a line; where the lines are too few in number to give a good ratchet they are doubled as in No. 4, the stop for the time of flight strip shown. The stops are ¼ inch thick.

THE STRIP-CARRIAGE FEED

The stop on the left side of the tool carriage acts against a lever that is connected to the shaft of the gear at the left of the machine which in turn acts on the gears that drive the feed pawl of the strip-carriage. It was necessary in designing this feed to overcome several difficulties. The circular travel of the strip carriage called for swivel bearings at the lower left set of gears and those at the strip carriage stop. The difference in length of stroke must nevertheless give a constant throw which is obtained by a cam on the back of the gear on the strip-carriage stop, which acts on a lever (not shown) moving the carriage the same distance on all strokes. This lever is held against the stepped cam by a spring shown at the left of the carriage stop below the shaft and connected with a pawl that acts against the stepped distance cam. The carriage stop is slotted on the right side for this pawl, which is held in a forward position by a light spring. When the pawl is driven out so that it forces the step of the distance cam next to the one on which it acts past point of the carriage stop, the spring on the right of the machine that drives the carriage compresses the lighter spring back of the pawl and brings the carriage stop up against the next step of the distance cam. As the lever is moved toward the work the pawl is released and comes into a forward position ready to do it all over again.

The distance cam is held against the carriage stop by a coiled spring in the clamp, which spring acts on a cam-shaped piece so that as the carriage travels in the tension of the spring decreases. The center of the bearing on which the distance cam revolves is the same distance from the carriage as the point of the carriage stop.

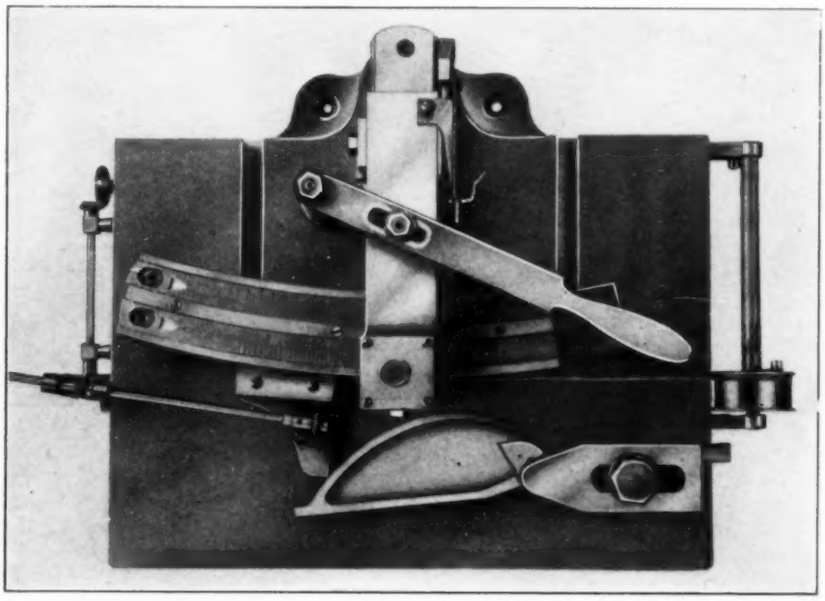


FIG. 2. THE GRADUATING MACHINE

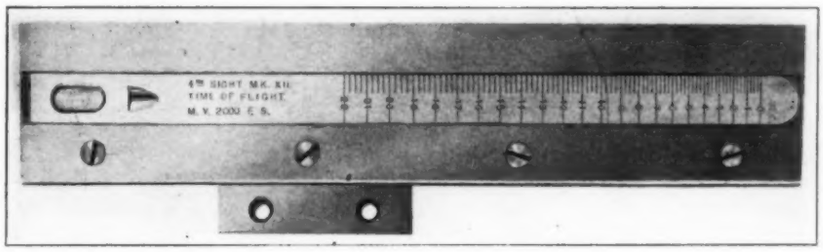


FIG. 3. A STRAIGHT STRIP

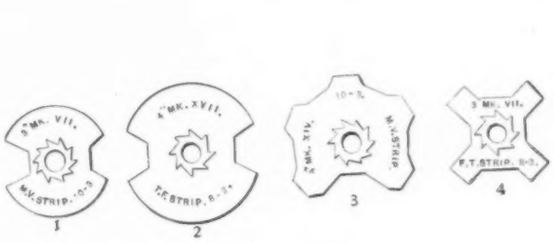


FIG. 4. THE STOPS

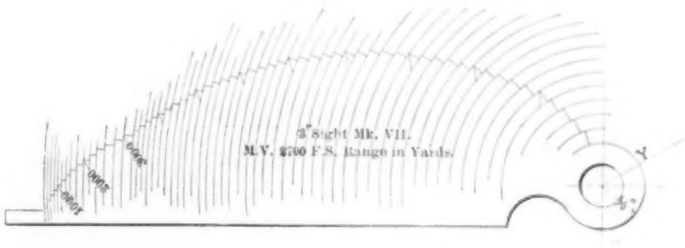


FIG. 5. THE FEED CAM

MAKING THE CAM

Fig. 5 shows how the cam is made. It is of tool steel ¼ inch thick. As it works on a radius greater than the one on which the chordal measurements are given in Fig. 1, it is necessary to find what these dimensions will be on this radius, which is a matter of simple proportion. I found that 1/16 inch was sufficient hight for the steps. By adding one-half inch (the radius of the hub at *Y*, Fig. 5) to the dimensions and using a pair of verniers it is possible to get the cam extremely accurate. With this machine one of the strips can be put in, graduated and taken out in two minutes.

Papin and the Invention of Steamboats

This summer a fountain has been erected in Cassel in honor of Papin, the inventor of the Papin digester and of the steam piston engine, and supposed originator of ship-propulsion by steam. The deity which crowns Papin on a relief-plate of this fountain carries a boat which is fitted with what some newspapers have called a "propeller." In reality it is only intended to represent an oar wheel, and the Papin committee of Cassel was well aware that the famous journey of Papin by a steamboat in 1707, from Cassel to Münster, where the irate fishermen destroyed the boat, is to a certain extent legendary. The boat was propelled by car wheels, driven by hand, and not by steam, and Papin never had the means for building a steamboat. But he certainly thought of steam propulsion for ships, though in his letters of 1704 to the philosopher Leibnitz, in which he speaks of his intended journey to England by his new boat, he mentions that he would not complicate the construction by putting a steam engine on board. He did not meet with any better support for this project in England than he had obtained in Germany, and he died a poor man in England about 1714. He was born in Blois, France, in 1647, and had, as a Calvinist, emigrated to England, where he met Boyle, and then went to Germany.—*Engineering.*

CORRESPONDENCE

Discussing Phases of Machine Design and Construction

Jigs and Fixtures for Machining Automobile Connecting-rod Brasses

The illustrations show a complete set of jigs and fixtures for rapidly machining crank-shaft and connecting-rod brasses for high-speed automobile engines. By their use much time has been saved as compared with our former method of procedure.

The brasses to be machined are split and are shown at Fig. 14. The first operation is to mill them straight across one end marked X, on a vertical-spindle slab miller. They are held in the fixture shown at Fig. 1. *A* is a gray-iron bracket with a center rib as shown, having two projections ⅛ inch deep on each side, which are for locating the half bushings by their cored holes and keep them vertical, as shown in Fig. 2. Four half bushings are put in the fixture at once, all of them being held by the center bolt *C* and the two clamping plates *B B*. *E* is a thin washer to fit the contour of the clamping plate *B*, and *D* is a slip washer ⅜ inch thick which can be slipped off when the nut is slackened and allows the clamping plate to be drawn back clear of the bottom flange of the brasses, which can then be lifted straight out.

We mill these with an inserted-tooth milling cutter 9 inches diameter, having "Novo" steel blades and run at a peripheral speed of 480 feet per minute with a table travel of 8½ inches per minute. After setting we can mill four in 43 seconds—once across making a first-class job and the cutters keeping quite sharp.

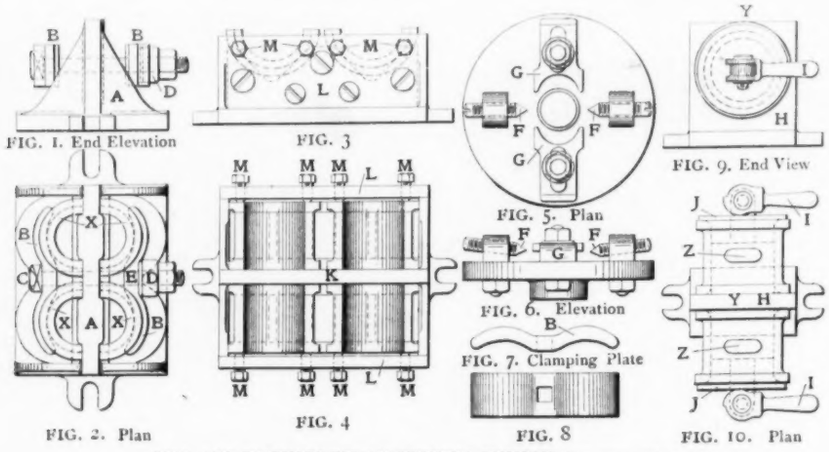
The next operation across the joint is done on the same machine, in the fixture shown in Figs. 3 and 4. Four half brasses are operated on at one setting as before. *K* is a gray-iron bracket with a center rib as shown, which is milled on both sides to bolt the milled ends of the brasses against. Two V blocks are cast on each side, shown dotted, which support the body of the brasses in the manner shown, the ends being gashed away to clear the flanges. The four brasses are dropped in the V's, the operator setting them with the planed top of the center rib, no gage being required, and tightening them up against the planed center rib, as shown in Fig. 4, with the set screws *M*, which operate through the steel plates *LL*, ½ in. thick, fastened to the front end of the V blocks by 5 fillister-head screws, as shown in Fig. 3. Four castings, when set, can be milled in 50 seconds.

The castings are then taken to the smith's shop and sweated together with solder, the brasses being made hot for this, and put with their milled ends on a surface plate to insure their being quite straight.

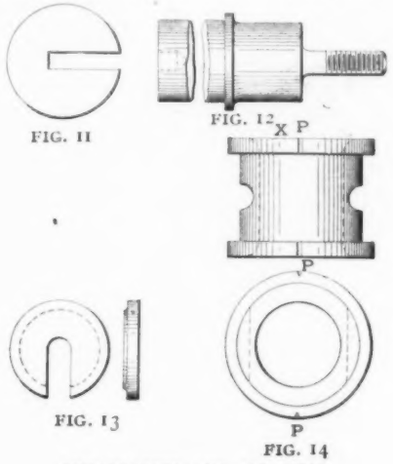
The brasses are then taken to a capstan lathe and bored on the face plate shown in Figs. 5 and 6. They are laid with their milled ends on the face plate, a small groove being filed with a 3-cornered file on the joint line at the milled end, as shown at *P* in Fig. 14. This only takes a few seconds and serves as a guide to set the brasses central. The two pointed set screws *FF*, carried at an angle in the dogs as shown, and set central across the plate, are just screwed up to the groove *P* to set them central—one screw only being slackened each time, the other serving to drop the work on. *G G* are the two forked clamping plates for holding the work on the face plate. The brasses are bored, reamed, faced and radiused on the front end, then turned round and put on a spigot and faced to length and radiused on the other end, after which they are turned on a capstan lathe (with a traveling rest—operated by a hand wheel), the spigot, Fig. 12, being drawn tight into the spindle by a long bolt passing through and screwing into the tapped hole shown at back end. The pin is turned a good sliding fit into the brasses, which are tightened up by a nut and slip washer fitting in the radius shown at Fig. 13.

The remaining operation is milling the clearance for the bolts across the joint at each side, as shown at *Z Z* in Fig. 10. This fixture is a bracket carrying a spigot at each side, shown dotted, on which the bored brasses are a nice sliding fit. The two levers *H* have forked ends, and are pivoted on round bolts, with milled ends, shown dotted in Fig. 10. The two levers have eccentric-cam ends, as shown, which operate against the slip washers *J*, Fig. 11. These washers are ⅛ inch thick and case-hardened, which allows them to spring slightly when the cams are forced against them.

The soldered joints in the brasses are set straight with a line filed across *H* as shown at *Y*. The cams for tightening do not giving a twisting motion like a wrench and therefore there is no danger of twisting the joint round when once set. Two brasses are put on the fixture at once, as shown. The cutters are spaced on the spindle, then set to hight and run across.



JIGS AND FIXTURES FOR MACHINING CONNECTING-ROD BRASSES



THE BRASSES AND AN ARBOR

about 25 seconds being the time required to perform this operation. They are then turned half-way round and milled on the opposite side, which completes the work ready for the bench hands.

"TRIPLE AUTO."

Coventry, England.

Punches and Dies for Wattmeter Frame Punchings

Coming under the head of blanking and piercing dies, one of the simplest jobs to make is, perhaps, the die for blanking and piercing wattmeter frame punchings, shown in Fig. 1. The construction and shape of this punch and die are such as to allow it to be made by machine, and not hand work. It is an easy matter to lay out a single die, but to lay out a die for cutting three or more blanks at one time is not so commonly understood. It is the custom in some shops to have a special man lay out the work before giving it to the die maker. In that way the best

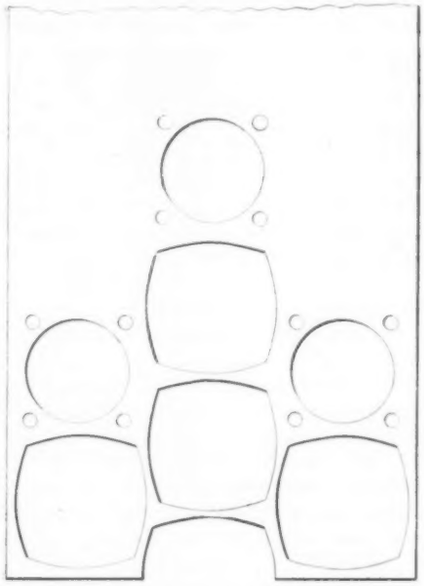


FIG. 1. SHOWING SCRAP AFTER PUNCHINGS HAVE BEEN PRODUCED

method is not always followed, as a die maker who wanders around the country often knows of better ways which he dares not advance.

POINTS TO BE REMEMBERED

One of the main points to remember when laying out a die of this kind is that all the holes from which the blanking and piercing are done must be laid out in exact position with relation to each other, so as to prevent the possibility of "running in." The required number of blanks must also be considered. For this particular job a large number are wanted every day, with the lowest running expenses. A die of this kind must be laid out central so that when in position ready for use in the center of the bed, it will not have to be shifted to one side or the other, in order to have it in line with the punch. The punch must also be laid out central, to correspond with the die in every respect. Fig. 2 shows the plan and section of the die for blanking and piercing three punchings at one time, as shown in Fig. 1. It will be noticed that the holes lie closely together, and very little stock is wasted. It will also be noticed that the three holes are not in a straight line. This is to save metal.

THE MAKING OF THE DIE

The die *R* is made solid, with the right-hand corner planed off at an angle of 45 degrees to half the thickness of the die, in order to save all surface grinding possible. The die is fastened to the cast-iron holder

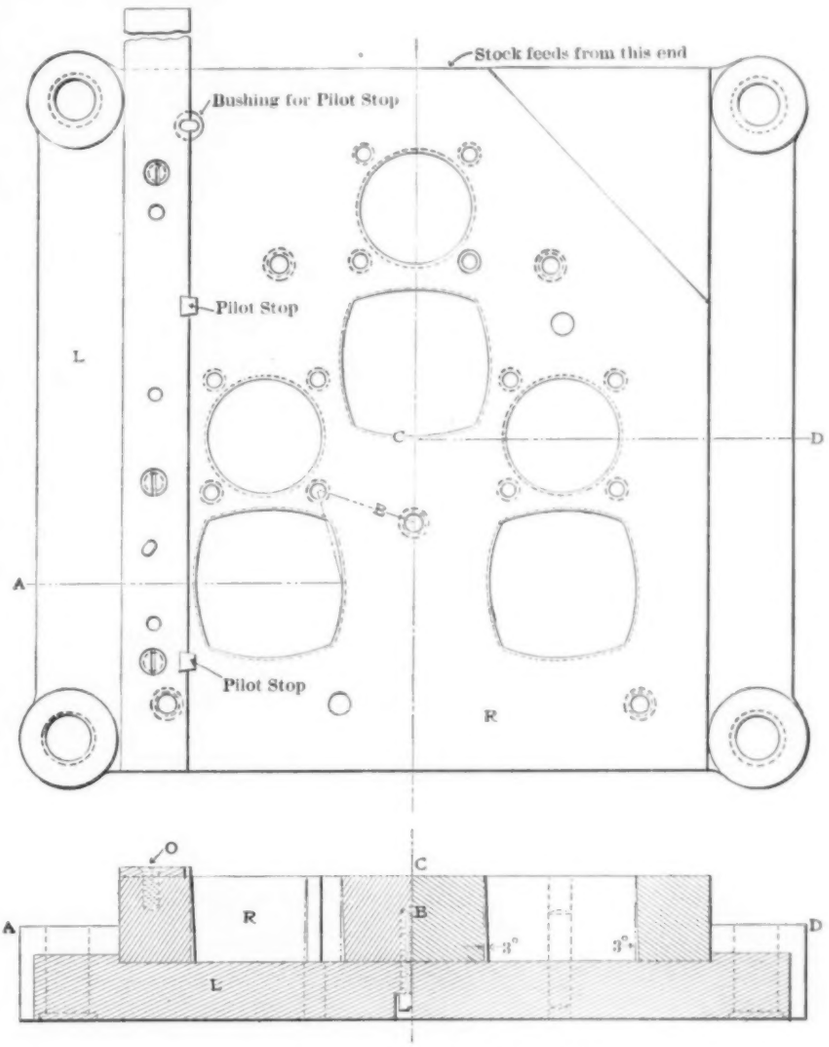


FIG. 2. PLAN AND SECTION OF THE DIE

L with five screws and two dowel pins up from the bottom. On the left-hand side a ⅛-inch guide plate *O* is secured with three screws and two dowel pins. Along the side are two pilot stops dovetailed into the die and plate. All the holes are bored in a milling machine. The die is strapped on an angle plate and drilled from the back. This is accomplished with a button system and test indicator. When bored to within 1/64 inch of size a one-degree taper end mill is used from the back till the required size is obtained in both the large and small holes. For the quasi-square holes the slotting machine is used by tipping the die one degree and working from the center of the four arcs on a circular milling fixture. In this way the die is made without using a file to any extent, except to finish off.

FINISH AND CLEARANCE

All the holes are lapped to size after hardening, should be perfectly round, and have a clearance of one degree. I have seen in some factories that they leave the holes straight for 3/16 inch from the surface, and then taper them three degrees; but that is poor practice, as the blanks will remain in the die, unless the punch runs through. In that way the punch and die will wear considerably. It is a fact that a blanking and piercing die will cut more blanks, run longer without sharpening, cut cleaner, and give better results all round if the punch and die are in perfect line. To line up a punch and die perfectly lies as much in its making as in laying it out. The three punches should enter the dies the same as if it had been only a single punch

and die. The benefit we derive from perfect line-up is that in operation the punches do not come in close contact with the edge of the die; they do not enter the holes, but stop at the edge close enough to cut a piece of ordinary paper. In that way they do not bear against the edges and dull the punch and die. In making the punches shown in Fig. 3, it must be made so that they will fit the die so close as to shut out the light, after being hardened and lapped to size. The bottom and top must be ground square with the side so that they will stand straight in the holder.

SECURING THE PUNCHES IN THE HOLDER

When ready to fasten the punches in the cast-iron holder *P*, mark them. After the punches are hardened, ground and lapped to size, place the punches and die together. Two parallels are laid on the face of the holder and the blanking part of the die, so that the punches just enter into the die. The punches are then soldered together with beeswax mixture, that gives very good results in holding work of this kind to a surface. You cannot get ordinary tin solder in between the parallels with good results. This beeswax mixture is made as follows: 7 parts of beeswax, 1 part of shoemaker's wax, and 3 parts of rosin. Melt the beeswax and shoemaker's wax in one ladle, and the rosin in another. When both are melted, pour them together and thoroughly mix them. When cool enough to handle, work in your hand for a little while, then shape into sticks ⅝ inch diameter; leave them on a cool surface until they become hard. Take a piece of flat steel and heat it a little; when the beeswax comes in contact with the hot steel it will run. Now run the point of the hot steel around the corners of the punches. When the beeswax cools off, you will find the punches stick sufficiently to spot all the holes while in that position. When everything lines up, take off the die and proceed with the drilling. When that operation is finished, turn the punch holder upside down, so that all the chips drop off. By using a sharp tool the beeswax can now be scraped off the punches and the holder. The wax can be used over and over again. After the holes in the holder are tapped and the punches screwed in place, the die is again placed over the punches with parallels between, and when in perfect line the screws are tightened, and the die is taken off. The dowel pin holes are now reamed straight; never harden the dowel pins, unless they are subsequently ground, as that will change the position of the punches, if they are not straight. In this way a perfect line-up of the punch and die can be depended on, provided care has been exercised in doing the work.

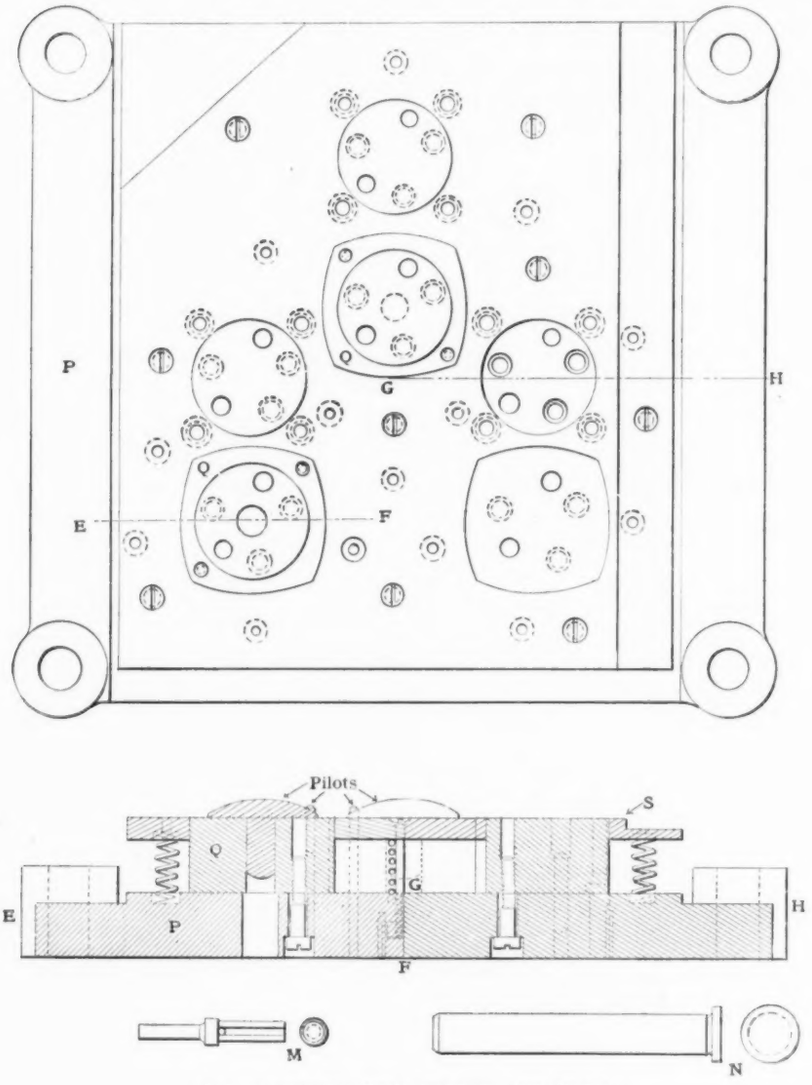


FIG. 3. THE PUNCHES, STRIPPER AND PILOTS

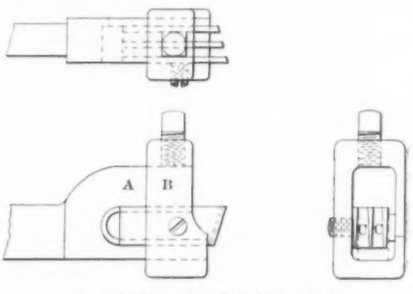
WHAT TO DO WHEN THERE ARE MANY PUNCHES OF SMALL SIZE

In locating the position for the piercing punches *M* and the sub-press pins *N*, it sometimes happens that the holes for the punches are so many and so small that they cannot be conveniently bored. The holes are then transferred by a drill that runs through the die, and is the same size as the piercing die, the die being used as a drill jig. After drilling, the hole is counterbored to the right size. On top of the two punches *Q* are one large and two small pilots to guide the metal while in operation; a stripper plate *S* is placed over the punches with eight flat-head screws, and adjusted with nuts from the bottom of the holder. These are not shown. Between the stripper and the holder, 15 spiral springs are placed to strip the metal. The sub-press pins, with their heads driven in the punch holder, and their bodies a running fit in the die holder, assure these two parts being in line.

R. A. ALMOND.

A Triple Cutting-off Tool

The triple cutting-off tool shown was used with good results in making thin brass check nuts in large quantities of ⅝- and ⅞-inch hexagonal rods on a common screw machine. The rods were drilled and tapped the depth of three nuts and these were cut off three at a clip.



A TRIPLE CUTTING-OFF TOOL

At times some of the nuts stuck between the tools, but were easily removed without loss of time by the operator during the cutting-off process with the aid of a piece of flat brass stock fastened in a handle. The body *A* of the tool is made of tool steel, and the yoke *B* of machinery steel. The two spacing pieces *CC* and the cutting-off tools proper are ground to size after hardening and tempering.

H. E. R. MANBRAND.

A New Design for Spring Chucks

Spring-chuck designs of various degrees of utility have been described from time to time in the columns of the AMERICAN MACHINIST, but it is believed that the form illustrated in Figs. 1, 2 and 3 has never received any attention up to the present. This form is intended for use on screw machines and turret lathes where very accurate work is desired, or where the work is in long pieces, and especially where it requires to be finished inside.

The form illustrated is intended for boring, reaming and recessing tubular pieces of machinery steel as indicated in Fig. 1, where the tubular piece of work is lettered *A*. This view is a longitudinal section of the forward end of a lathe spindle, the spring chuck and the members required to operate it, or secure it to the

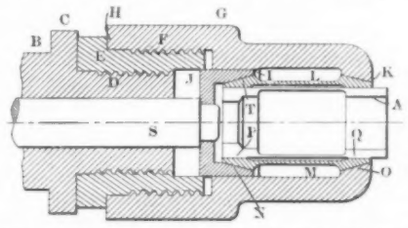


FIG. 1. SECTION THROUGH SPINDLE CLOSER AND COLLET

spindle. Figs. 2 and 3 show the chuck in detail, being, respectively, front and side elevations.

Referring to Fig. 1, the nose of the lathe spindle is indicated by *B*, and it has the usual collar *C* and threaded part *D*, upon which is screwed the internally threaded sleeve *E*, which is also threaded externally at *F*. On the thread *F* is screwed the outside sleeve *G* hard against the shoulder *H* of the sleeve *E*. The sleeve *G* has a cylindrical bore at *I* to fit the sliding cup-shaped closer *J*, and has an internally tapered portion *K* at the extreme forward end.

The spring chuck proper *L* consists of a barrel *M*, and tapered portions *N* and *O*,

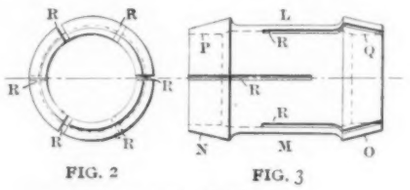


FIG. 2 FIG. 3

THE COLLET

while the inside of the chuck is bored to fit the work, care being taken to recess the central part of the bore, leaving bearing spaces *P* and *Q* at the ends. Three saw cuts *R R R* are made in each end of the chuck, and are necessarily staggered as indicated, thus giving the necessary springing feature to the chuck, which is hardened and drawn to the proper degree of temper.

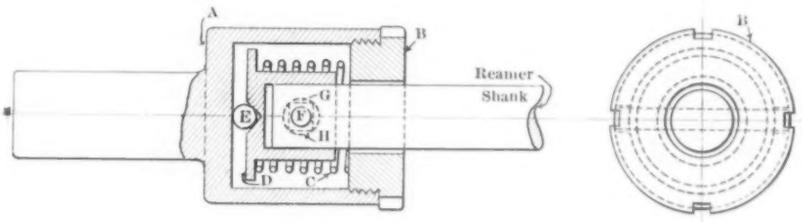
The cup-shaped closer *J* is attached to a sliding rod *S*, which extends to the rear end of the lathe spindle, where means are provided for sliding it to and fro, and locking it in its working position, which is the one shown in Fig. 1.

The closer *J* has an internally tapered face *T*, and the spring chuck *L* being placed with its tapered face *N* against the face *T* of the closer, and its face *O* against the face *K* of the sleeve, the rod *S* and closer *J* are forced toward the right, thus forcing the spring portions of the chuck inward and clamping the work.

The advantages obtained by this style of chuck are greater gripping capacity with the same exertion of force for operating as required for the older styles of chucks, and greater accuracy, by having two points of support and thereby decreasing the inclination to "wabble" where the work is long. C. D. KING

A Floating Reamer Holder for the Turret Lathe

At page 580 there appeared an article describing a floating reamer holder for turret lathes. I thought the holder was rather simple and inexpensive, so I decided to make one for my own use. On examining the sketch, I found that with the holder made as shown, there was nothing to prevent the reamer from pulling forward till the pin reached the end of slot *G*. If this were done (which is quite possible when the reamer is being backed out of a hole, or if the holder is picked up by the reamer) the ball would drop out of position, and it would be difficult to get it back again without taking the holder to pieces. Also when any pressure comes on the reamer from the cut, the pressure would be transferred directly to the ball, and would prevent it from rolling, to find its correct center. Therefore, I modified the sketch a little, and have inclosed one showing how I made it. The body *A*, nut *B*, spring *C*, ball *E*, and pin *F* are just the



FLOATING REAMER HOLDER

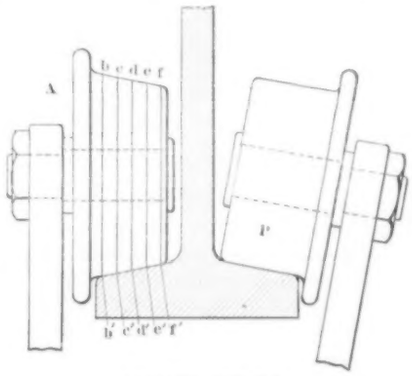
same as before, but instead of using a washer (like *D* in the sketch referred to) to take the pressure of the spring, I made a piece which fits over the reamer and has the ball center in the end. This piece is shown at *D*, and it will be seen that the reamer has a little movement forward or backward without moving the piece. Again, when the reamer is cutting, the pressure does not come on the ball, but on the back of the square slot *G* against which pin *F* rests. The ball is always free to roll. The hole *H* is in piece *D*, and is simply clearance round the pin *F*.

CONRAD.

Trolley Wheels

There seems to be some difference of opinion about the design of wheels for trolleys for carrying loads, to be used on I-beams. Among others I recently noticed an illustration of one in which conical wheels were used upon the beveled flanges of an I-beam, after the manner of the wheel *A* in the illustration.

I had always supposed that conical wheels were only adapted to circular path-



TROLLEY WHEELS

ways, which would preferably have a beveled face, corresponding to the angle of the conical wheel.

Referring to the illustration again, a number of lines, *b*, *c*, *d*, *e*, *f*, have been drawn on the wheel *A* to represent circles on the periphery, and assuming that there is a load on the trolley, it is evident that pressure is brought to bear equally at each of the points, *b'*, *c'*, *d'*, *e'*, *f'*.

Now when the trolley is moved, it is evident that the linear speed of the circle *b* is greater than that of any of the other circles, *c*, *d*, *e*, *f*, so that the wheel is bound to slip at the point *b'*, if the contact points, *b'*, *c'*, *d'*, *e'*, *f'*, bear truly on the flange of the I-beam.

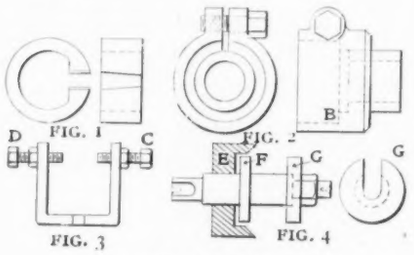
Slipping will also occur at *c'* as well as at intermediate points, so that considerable friction will have to be overcome to move the trolley, if there is even a moderately heavy load.

The wheel *P* is made cylindrical, and will run upon a beveled flange without the slippage incident to the wheel *A*, and therefore seems preferable to it.

C. D. KING.

The Manufacture of Friction Clutch Rings

The accompanying sketches show a method used for the rapid production of cast-iron friction clutch rings. Fig. 1 is the ring as generally used; the flat on the circumference of the hole indicates that no machining is done to that part. The practice of using bar steel in the manufacture of these rings, followed in many



THE WORK AND THE TOOLS

shops, is to my mind a far costlier method, necessitating the boring of the hole. I have found in my experience that a cast-iron ring, well fitted and free from flaws, is just as strong and durable, if not more so, than a steel ring, there being less chance of cutting and roughing the bearing. The scale in the hole also adds considerably to the strength of the ring.

The rings should be cast in the form of sleeves about two feet long. The first operation is to turn this sleeve in the lathe on two cone centers having flats on them to correspond to those in the hole. This keeps the holes concentric with the outside. About 0.010 inch should be left for grinding, as the rings are somewhat distorted after milling.

The next operation is cutting off, which is quickly performed by advancing the cutting-off tool to, say, a sixteenth from the hole, cutting up the entire sleeve this way, carefully cutting out such parts as have sand holes, cracks, etc., after which the rings are easily separated with a chisel and hammer.

Fig. 2 shows a chuck in which they may be quickly faced to size and have one corner chamfered or rounded. The depth of the hole from *A* to *B* should be the required width of the ring. This will save measuring and make all rings of uniform width by placing one faced side of the ring solidly against the back and then facing even with face *A*. This chuck may be screwed on the spindle nose or have a taper shank to fit in the live center hole.

The next operation is milling the taper slot, which can be done rapidly and easily by clamping one at a time in a swiveling vise, no great care being required to set them, except to get the flat parallel with the jaws, which can be done near enough by the eye. Fig. 3 shows a handy device not only for this but for many other jobs which come up in milling-machine practice. It is clamped on the table at the screw end of the vise. The vise is then set correctly for cutting one side of the slot, which is done with an ordinary slotting cutter, and the screw *C* is then adjusted to touch the side of the vise screw. Cut the slot and repeat the operation on other side, setting the screw *D*. The vise can then be swiveled from *C* to *D* quickly and with no chance of mistake.

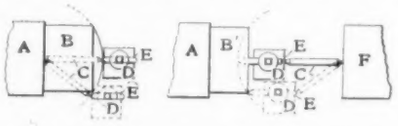
The last operation is grinding. The mandrel shown in Fig. 4 permits this operation to be easily and rapidly accomplished. The time-saving feature of this mandrel is the sliding collar *E*, shown in section, which centers the rings accurately by laying one of them on the washer *F* and sliding *E* up to it and then clamping. The washer *G* should be slotted as shown to avoid removing the nut entirely every time a ring is removed.

TANGENT.

Turning Convex and Concave Faces without Special Attachments

When serving my apprenticeship in an Eastern shop, I came in contact with a lathe job; the method employed in doing it may be of interest to your readers.

The design of an oil-step bearing was such that it necessitated two plates, having, respectively, concave and convex faces,



TURNING CONVEX AND CONCAVE WORK

as shown, which must fit together with reasonable accuracy.

At first I turned these faces by operating both feeds at the same time, by hand. This method, however, required too much time and care, and proved inaccurate at best.

By consistent reasoning, I conceived an idea which I thought would prove satisfactory. Selecting a piece of ⅜-inch round, cold-rolled steel *C*, slightly longer than the radius at which the face must be turned, I turned a taper on each end. I then blunted each end slightly until the rod was exactly the length of the required radius to be turned. It will thus be seen that I had merely a pin gage of length equal to the radius of the face to be turned.

I next turned my attention to the lathe. On the tool-slide *D* I scribed a vertical line which would, if projected, have passed approximately near the center of the tool in the post, and center-punched this line conveniently with relation to the headstock *A*, i.e., so that I could extend the pin gage from the tool slide to the headstock without interfering with the work *B* or chuck. I repeated this operation on the opposite side of the tool slide, i.e., the side toward the tailstock *F*.

On a vertical line, drawn from the center of the lathe, on both headstock and tailstock, I center-punched a point horizontally opposite the center-punch marks, previously described, on the tool slide. Placing the pin gage *C* in the center-punch marks, between the headstock and the tool slide, I so adjusted the tool *E* that when it had reached the center of the work, the pin gage would coincide with the longitudinal center line of the lathe. Then I set the friction feed so that the pressure on the pin gage, when in operation, would be as little as possible.

It will thus be seen that by starting the cross-feed the tool will be forced about the radius as governed by the pin gage.

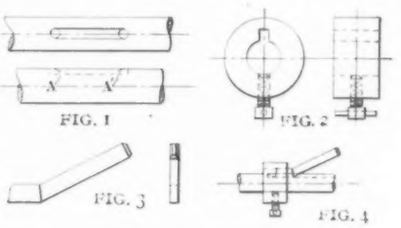
So much for the convex plate. Now for turning the concave plate *B'*, it is only necessary to place the pin gage in the center marks between the tailstock *F* and the corresponding side of the tool slide *D*, and repeat the operations as described for the convex plate *B*.

My work, when finished, proved to be quite accurate, and was entirely satisfactory, particularly so as the output was tripled.

R. S. H.

Drifting the Ends of Milled Keyways

The illustrations show how a job of the "mean, puttering" variety was converted into a "cinch." Fig. 1 shows a shaft having a keyway milled in it for a ⅜-inch key. Clearance holes were drilled at the ends previous to the milling operation. The job in question lay in making the keyway flat its whole length; i.e., taking off the points *A A'* left by the milling cutter. The method formerly employed was to reduce them with an end mill, an expensive method when the cost of the end mills was taken into consideration. Figs 2 and 3 show the tools required by the new method, originated by the foreman of the department handling the shafts.



THE JOB AND THE TOOLS

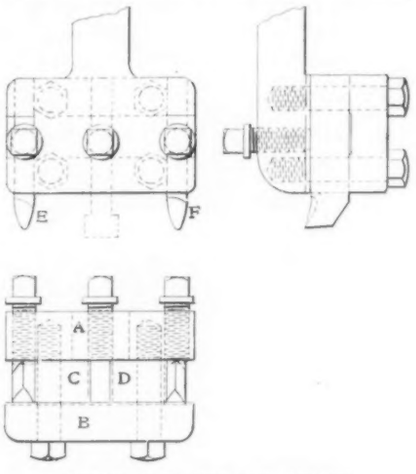
Fig. 2 is a steel collar bored a running fit for the shaft, having a slot ⅜ inch wide (the same width as the keyway) and about ⅝ inch deep.

Fig. 3 is a drift, made to fit the keyway on the sides, the thickness being the depth of keyway plus the depth of the slot in the collar. Fig. 4 shows the tools assembled on the shaft ready for use. The remaining part of the operation will be obvious. By this method the production

was considerably increased; furthermore, the cost of the upkeep of the tools was reduced to a minimum, which is a most important item. J. PRICE.

A Multiple Planer Tool Holder

The illustration shows a multiple planer tool holder for machining plain surfaces in quick time. All parts, except the three screws for holding the tools, are made of machinery steel, case hardened. The tool-holding screws are tool steel and have their heads and points hardened and tempered. The holder is made in four parts, part *B* being bolted to part *A* with four 5/8-inch hex. head cap screws which pass through parts *C* and *D*. The shank on part *A* is 1¼ inch by 1½ inch to suit a four-stud tool post on the planer. The inner surface of part *B* is recessed to give the tools two bearing points. The roughing tools are held in the outer slots and the flat-nose finishing tool is held in the central hole as shown by dotted lines. When in use the roughing tool *E* is brought to the edge of the work and the tools are then fed down until tool *F* has reached sufficient depth of cut, then the cross feed is started, and when tool *E* reaches the surface left by tool *F* the tools are raised and shifted along so that when fed down again tool *E* will begin to cut where tool *F* stopped. In this way a roughing cut is taken over a surface in a little more than half the time it would take a single tool to do the work. The



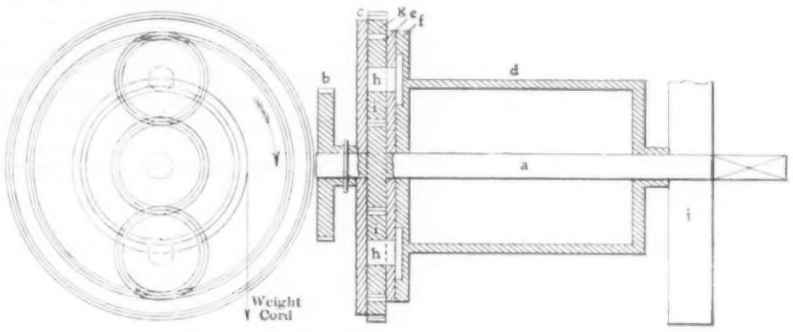
MULTIPLE PLANER TOOL HOLDER

roughing tools remain set for succeeding pieces, and the finishing tool is shifted clear of the work while the roughing cut is taken. H. E. R. MANBRAND.

Planetary Gears

The accompanying sketch shows a system of planetary gears suitable for a high-grade clock, the chief point being that it is a maintaining gear by which the weight can be wound up without affecting the rate of the clock.

On the steel winding shaft *a* is fixed with a pin the ratchet wheel *b*, the center spur wheel being generally solid on the shaft. The disk *c* and the drum *d*, *e* and *f*, before being geared up, are free to turn on the shaft *a*. For convenience of cutting, the internal gear *g*, which by its external teeth drives the clock, is usually fixed to the disk *c* with eight small screws not shown. The two steel pins *h* carrying the idlers *i* are fixed to *c* with three small screws each, and when fixed *e* and *f* are screwed together. The center spur wheel and the two idlers have each 18 teeth, and the internal gear 54. The



A CLOCK MAINTAINING GEAR

outer wheel is made to suit the clock. At *j* is one side of the clock, the other not being shown. Y. K.

York, England.

Why Machinists Do not Read

I have been much interested in what has been said, and the various reasons given why machinists do not read. It is a question I have speculated on for many years.

It certainly is a fact that a great majority of machinists and steam engineers do not read. I ascribe it to two reasons: First, the reading habit, to become fixed, must be acquired when young; otherwise the mental training necessary to dig a good thing out of a paper is lacking, and, I think, is seldom acquired in later years. Some men have a positive distaste for mental exertion; in fact, I believe there are many people who get through life with caked brains, so incapable do they seem to be of mental effort. Second, there is a lack of ambition. The ambitious man feels the need of knowledge, and gathers it from all sources. Such a one naturally becomes a close reader of literature pertaining to his line of work.

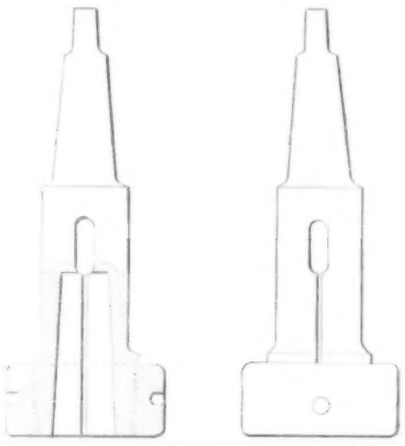
In my own case, the reading habit was inculcated in me when a child by my mother, who was a great reader. Naturally, when I began to work with machinery, I became a close reader of anything pertaining to it, and have for years been a subscriber to the best papers devoted to my calling. Of course, the AMERICAN MACHINIST and *Power* head the list.

My method is to glance over the articles which I think are not likely to contain anything of use to me, to make sure there is nothing there, and to go over carefully that which I think is likely to contain information which I need. If you do not find this worth publishing, I have at least had the pleasure of expressing my views on a subject which has interested me for years.

STATIONARY ENGINEER.

A Socket for Broken Shank Drills

There is hardly a manufacturing concern that does not have a box of drills in the tool room with the flat ends of the shanks broken off. Some shops have them turned down and new shanks made. A simple socket is shown in the sketch for holding such broken tang drills. A tool of the kind that will hold a 2-inch drill costs about $2 when made in the very best manner. I saw one of these



A SOCKET FOR BROKEN SHANK DRILLS

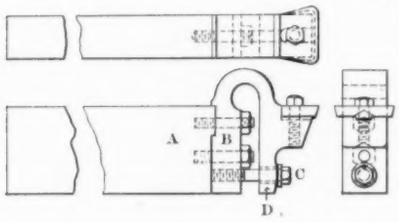
sockets or chucks carrying a 1-inch twist drill on a rapid feed drilling cold-rolled stock. You will notice that the thread is tapering and is fitted with a steel collar, drilled so that a spanner wrench can be used on it. Our sockets were made of machine steel, but it would be much better to construct the whole thing of tool steel, give the body a spring temper and harden the collar so the spanner wrench will not wear out the holes. The taper on the thread should not be too great. The saw slits ought to be about 1/16 inch wide. With a little care this makes a powerful chuck. Three sizes will answer for a

large shop and will save many dollars. This device was gotten up by C. K. Burrows. C. R. McGAHEY.

Augusta, Ga.

A Goose-neck Finishing Tool

The goose-neck spring tool shown in the illustration is used for taking the finishing cuts and for forming the fillets on crank shafts. The shank *A* is a piece of machinery steel 1½x3 inches. Part *B* is made of tool steel, and is fastened to the shank



GOOSE-NECK TOOL FOR CRANK SHAFTS

with two ⅜-inch studs and nuts. The loop on this part is hardened and spring tempered, and its tension is adjustable for light or heavy cuts by tightening or loosening the screw *C*, which passes through an elongated hole at *D*. The outer surface at *D* is curved to keep its contact point central with the head of the screw *C* at all points of adjustment. A tongue and groove, and a ⅜-inch hex-head cap screw hold the cutting tools.

H. E. R. MANBRAND.

Starting a Shop

Dixie's article at page 581 reminds me that I might have gone further in my own article at page 412 on this same general topic and pointed out a way in which men are often taken in.

FINANCIAL ASSISTANCE ADS IN SUNDAY PAPERS

There are in most of the Sunday papers advertisements of men who undertake to find capital for the exploiting of inventions or rescuing businesses which are on the downhill side of their existence. A letter of inquiry to any of these advertisements elicits a reply so sanguine as to their ability to provide all necessary working capital that it seems the most natural thing to feel that you have overlooked some easy way of raising money. So you write again or call, explain your necessities or your wishes and ask terms. You find them entirely sanguine still, but in a moment of confidence your advertising friend permits you to share his secret. He has no money, it will cost quite a little sum to get your business incorporated, since his clients do not invest except in corporations, and he will have to get out circulars, etc.; he will have to ask you to advance a sum sufficient, etc., etc.

Now right here let me advise you when you call on these people to wear your old clothes. The amount needed for these things, etc., etc., is just exactly in proportion to your apparent ability to pay. If you look too poor he may not be willing to talk with you at all, in which case you have made money by your garb. If you advance the money you may then sit down and wait. It takes quite a while to get a corporation charter through and there is real truth in his statement that it is useless to approach moneyed men with a proposition like yours until the charter is granted. If he added that it never would be of any use to approach them, he would only be telling the whole truth. But after a while the charter comes, duly certifying that the Blankety-Blank Manufacturing Company is duly authorized to issue stock up to a million dollars, of which ten dollars is paid in, all sealed with a big seal on a splash of sealing wax.

Now you expect to see money rolling in, so you buy a stock-certificate book with a few hundred certificates. Then you begin to write hurry-up letters to your financial agent, but he says that all the men with the money are at the sea-shore and he can't do business with them, and he guesses he will go too. So he goes off and spends your money having the time of his life, while you struggle along wondering if you can hold out till the money comes. By and by, back he comes with a tale of woe and a tale of hope. No money to be had, but he has struck a new scheme to make it, a perfectly sure thing.

THE LIFE INSURANCE SCHEME FOR SECURING INVESTORS

He will get your life insured, and every time an investor puts in one thousand dollars, he will spend half of it to buy a paid-up life insurance policy for that amount due in 30 or 40 years, to deposit with the investor as security for his principal. It is a mighty plausible scheme and he seems perfectly willing that you should pay 10 per cent. dividends on the whole thousand, and yet give you only $500 of it to work with. But it will cost him another hundred or two to get out new circulars and mail them to his thousands of investors who are only looking for something on which he will set his seal of approval to invest. If you let him have this last instalment of money you have done a good thing in one way. He will not come around to ask for any more. He will try to fade out of your sight with all possible celerity. Of course, these chaps do occasionally put something through They get propositions which can't help going through from their own merit or originality. But in general, they live and live well on advance fees. You may suspect that the number of circulars printed and sent out was only a small fraction of those for which you paid, but you cannot prove it. As for the insurance scheme, it seems unlikely that after the insurance companies have gotten through with your money, there will be any dividends left for you or anybody else to squeeze out.

ONLY TWO WAYS TO GET MONEY

As a matter of fact there are only two ways in which a struggling machine shop can hope to raise money; borrow it or have it given. If you borrow you must go either to a bank or private individuals, who work on the same principles, viz., to see that they have plenty of security. If you go to your customers or the men you buy materials of, either of them expects you to keep on dealing with them so that they can make both profit and interest money. By having money given you, I mean that you sell stock, which is the same thing, as it only obliges you to pay dividends if convenient, or if you cannot get rid of all your profits in salaries, etc. You never expect to pay back the principal at all. Now the only people that are likely to give you money are idiots, from whom it is unlawful to take the money. Your supply men and customers expect to see a profit coming to them, also expect to ultimately get hold of enough stock so as to own you and your business.

THE OUTLOOK NOT SO BLACK AFTER ALL

A poor outlook you say? No, it is the best outlook in the world. Someone has said that if a man could not do business *without* money and make it successful, that he could not *with*. There is a lot of truth in it. It may be the fault of the business or it may be you, but in general if you cannot make a small business stand up by itself you can't make a large one do it. "ENTROPY."

Not Doing Worthless Work

A short time ago I was working in a jobbing shop where we received a peculiar order which compelled us to charge for work we did not do.

A sawmill had bought a split cast-iron pulley and when they received it, it was not put together properly. The two halves were out of place 1/32 inch so they could not get the shaft in.

They calipered the bore and shaft, then sent the pulley to the shop with instructions to bore it out 1/32 inch on a side and make it two inches. We telephoned them that the pulley was all right and explained the trouble but they replied saying we should do as they said as they knew what they were about.

We loosened up the bolts, put a shaft through the bore and pulled the two halves together, tried a reamer in and returned the pulley. We also sent a bill for what it would have cost to bore it. It must have been satisfactory for we never heard any complaint. C. E. H.

The Inventive Microbe

While our medical scientists have recently discovered in most of the diseases that man is heir to a particular kind of living organism which they call a microbe and claim that the workings of this parasite are manifested by the outward symptoms of the several diseases, we have yet to learn of any progress being made toward the discovery and destruction of that very prevalent and dangerous parasite, the inventive microbe.

Gentlemen of the medical profession, here is an untouched field wherein lies the oportunity of covering yourselves with glory by furnishing a remedy that will stop the ravages of this brain-destroying monster.

RETROSPECTION

As those of us who have been many years in the harness look back over the road we have traveled, and notice the many hundreds of physical and mental wrecks that have come under our personal observation, wrecked on the rocky roads leading to and from the Patent Office, is it wonderful that in view of all this distress, we should question whether it is all made good by the success of the very few we have known who have traveled these roads to their financial and mental betterment?

My experience is undoubtedly duplicated by every man who has had charge of a general jobbing shop. We can all look back and recall the hundreds of men who have called upon us each year, bringing their crudely constructed models or sketches, and assuring us that they had made a discovery that was bound to revolutionize the industry to which it pertained.

In some cases the man informs us that he has been from five to twenty years perfecting his invention, and has spent every moment of his spare time and every dollar earned above his actual living expenses to this end. He has applied for a patent and expects to hear from the application every day, and now he wishes our estimate of the cost of a full-sized machine. Of course, he makes it clear to us that he simply wants this one machine for demonstrating purposes, and is very positive that as soon as he can "take the road" with it, orders will come in by the thousands, as there will be an unlimited market for it as soon as introduced.

He is very fearful that in a month's time our shop, with its limited equipment, could not begin to supply the demand, but is very much pleased to notice that we have plenty of room to build, and that our steam plant seems much larger than we need at present.

MILLIONS IN IT

He talks fluently of the millions of dollars to be made in the manufacture of this article, speaking with an enthusiasm closely bordering on insanity. We tell him that we will figure on the job and give him an estimate in two or three days; he is very anxious that we should expedite matters as much as possible, as he wishes to get right to work as soon as his patent is allowed, and that is likely to occur the following day. We agree to get at it at once, and he takes his leave walking on air.

THE HARD-HEARTED, CLEAR-HEADED SHOP PROPRIETOR

After looking the matter over in a cold business way, we are forced to the conclusion that the machine will not be a success; that it would require a great deal of experimenting before there would be the slightest chance of obtaining the results expected, or we discover that the idea is not new, and that the chance of obtaining a patent, to our notion, is decidedly slim.

When our customer returns we tell him that we are unable to give him even an approximate price on the machine; that we think it cannot be made a success, or that the idea is decidedly old. He scornfully tells us that after spending 20 years of his life on this thing, he ought to know something about these points; what he does want to know is, whether or not we will make the machine. We tell him that if he insists on building it, we will do his work, with the distinct understanding that our responsibility ends with the providing of first-class material and the best of workmanship; that he must take the risk of the machine failing to be a commercial success, and that we would require a liberal deposit before starting the job, and when that was used up, should call for another, and so on, until the work was completed.

A CUSTOMER LOST

The result of this is that our customer leaves us with a highly offended air, saying that he will look further and see if he cannot find someone who is much more in need of work than we appear to be.

A HARVEST FOR FAKERS

Each of my readers who has been identified in a mechanical way with any manufacturing or jobbing concern is acquainted with this man. He is found in every community throughout the land; he has invented everything from a jews-harp to a locomotive. He is the common prey of the disreputable patent solicitor and the fake patent-selling agency. The one procures for him a patent, consisting of one or two combination claims that are absolutely meaningless and entirely worthless, making the value of the alleged patent less than that of the paper contained in the document before it was printed. The other keeps his invention before the buying public, who are just walking over each other in their efforts to purchase this kind of property—this of course, as long as his money holds out.

ANYONE LIKELY TO BE A PATENT CRANK

To my mind one of the strange things about this man is that in many cases he is found to be a machinist, and often a man of recognized ability in his vicinity, or at least that was the case before this infernal bug got a firm hold under his hat; after that it is but a short time until we find that he has left his position or been discharged, because he could no longer keep his mind on anything pertaining to the shop, and is now devoting his entire time to the perfecting of the "flying machine" that he is so positive will make make him suddenly rich.

THOSE DEPENDENT ON HIM SUFFER

This man seems entirely oblivious to the fact that he has spent all his savings and deprived his family of all the enjoyments of life, and possibly many of the necessities, but continues chasing this will o' the wisp until his borrowing capacity is exhausted, and he finds himself absolutely down and out. If his nerve is not entirely gone by this time, he will start in the shop at a moderate wage, and spend the remainder of his life getting even, and becoming more disgruntled every day he lives.

WHAT ARE THE CHANCES OF REWARD?

When we consider the prevalence of this disease, and know that there are more men afflicted with it than there are confined in our insane asylums, and that most writers and manufacturers are continually harping on stimulating the inventive ability of our young mechanics, and as the average young man regards the word invention as referring only to the Patent Office records, would it not be well to occasionally give him some statistics on this subject? For instance, that only about one out of a thousand patents procured and retained by the individual patentee ever bring back the money spent in obtaining the patent; that the fact of having obtained one or two worthless patents has been the direct cause of preventing the shop advancement of a great many men. Whereas, if the time and energy used in getting their names in the Patent Office records had been applied toward bettering and lessening the cost of the processes of manufacture coming directly under their supervision, their advancement would have been sure, and their mechanical ability largely increased.

SUCCESSFUL INVENTIONS ONLY ARE HEARD OF

The young man should remember that when a man obtains a really good patent, and is successful in selling it for a considerable sum, the news is published throughout the mechanical world but nothing is ever said of the nine hundred and ninety-nine other fellows, who failed to get returns. A gambler's chance on a pack of cards would look a sure thing as compared to this; nor should the money loss be regarded as the greatest disadvantage in a case of this kind, for once this microbe finds lodgment under the young man's scalp he will suffer a very serious enlargement of the head, which will likely

disqualify him for the work that falls to his lot, if it happens to have nothing to do with inventing things, and heroic treatment, sometimes the very serious surgical operation of removing the young man's head is necessary before the required relief is obtained. He who assists in removing this dangerous parasite from our mechanical industries will render valuable service. NEW YORKER.

Electric Motor Drive

Mr. Schaeffer's article at page 571 on motor drives evidently refers to large installations of individual motors only. While he says nothing about the form of motor which he uses, whether single, two or three phase or direct current, it strikes me from what experience I have had that he must have the older style direct current to have obtained as good results as he reports. His article makes me feel that if all attempts to use electric power work as poorly as one of which I was a witness last summer then a word of warning would not be amiss. If I am right then others will undoubtedly corroborate me and if wrong then they will most surely say so.

During the summer I dropped in to the old shop where I had put in a lot of time, just to renew acquaintance, and found them running with electric power. When I was there fifteen or twenty years ago the shop was of about the same size as it is now; possibly they are running more line shafting, but their work is enough lighter so that the power required ought not to be much more. They have done away with possibly a hundred feet of shafting and two or three quarter-turn and quarter-twist belts. When I was there before I remember having to wheel in the coal quite a few times and in the summer it required only about 800 pounds per day. Today they are wheeling in double that amount, even when they are doing no heating. They have a fine plant; a compound engine running a two-phase dynamo, two-phase self-starting motors, everything up-to-date and fine, but to what purpose I do not know. Whether they know the ropes or not may be a question, but they certainly are paying a liberal price for whatever convenience they may be getting. Worse than all that they are compelled to run a large engine, much larger than their normal load would seem to require, just because the rush of current if they start up a motor when the others are running will stall an engine of a size to properly handle the load. It costs so much to start a motor that they find it cheaper to let a line shaft run, even if only occasionally wanted, than to stop and start it. If the individual machines had been large enough to make individual motors pay, and the motors had been of the direct-current variable-speed type, then I believe there might have been a substantial gain.

The alternating current is an attractive thing, whether single or two phase. If we have a power plant miles off in the hills we can generate current at death-dealing voltages and ship it down by wire with astonishingly small loss, and then transform it to workable voltages with simple converters and run it through motors without commutators and get power. But these motors do not seem to be built for variable speeds with anything that can be called efficiency and as shown above they eat up power terribly on starting. They have a great advantage in their simplicity of construction and in getting rid of the commutator, but a well built direct-current motor will stand about as much abuse as anything ought to. A direct-current transmission over a long line is expensive but most shop transmissions are relatively short. Motors can be put in anywhere which are standard makes and which will run with sufficiently good efficiency so that we can afford to put in some motors larger than necessary to keep the number of different sizes in the shop small. Then a spare armature or two and a few spare field coils render the stoppages for repairs small. If we want to start up a line of shafting to use a machine a half an hour we can afford to do it. Give me a direct-current system every time until they get past the experimental stage with the alternating. CON WISE.

Doing Worthless Work

Having read the different letters in the AMERICAN MACHINIST, under the above heading, I have felt a desire from time to time to go around the shop and see what worthless work I could find, *and really* the result is surprising. One finds worthless work everywhere, in drawers and on racks, visible and invisible; foremen's botches and turner's botches, botches of every size and description. I see a rack, on which are 15 castings of different kinds labeled "Not required." Being on the lookout for worthless work, I inquire the reason. The charge hand knows nothing beyond the fact that the drawing office had sent out word that they were not required. They represent at least 100 hours' work turning, drilling, milling and slotting, absolutely without value and *nothing has been placed on the engines in their stead.*

After last stock-taking I found that the stock-taking had been thoroughly done. My lathe was almost upside down, the accessories, comprising bolts, nuts, clamps, etc., were on the next fellow's lathe. After sorting our respective belongings, and putting them in order, I found that several spigots and centers which I had made for various jobs, were missing. I didn't accuse Jack or Tom of having them, but I went and looked just the same and found that they were in the same fix. On going further afield, I found that we were all alike. On inquiry, I learnt that all these articles had, during stock-taking, been consigned to the scrap-heap. I had been robbed of the result of about 20 hours' work. Striking an average loss of 10 hours' work per man with 60 men, we have a net loss of 600 hours' work. Obviously the fault lay with the fact that each man has to make what he needs himself, and only he knows its value, but the fact remains that this result of 600 hours' work was thrown away, and had to be replaced.

Take another case of a different character. An experiment was being made with a water-cooled valve for a large motor. The crown of the valve was hollowed out and threaded to receive a cap, which was to be screwed in tight and riveted over. The turner had done his work correctly to drawing, leaving it rough from the tool, and was preparing to screw the cap in, when the foreman came along. Looking at the job and seeing what the man was about to do, he asked him if he intended to screw the cap in, with the inside in that rough condition. The turner intimated that he did and was thunderstruck at the reply. "Then you just put it on one side and scrape and polish those tool marks out." Try and imagine it! Scrape and polish for a water service!

Some months ago, I saw four men working on a 6-inch shaft. They appeared to be hustling somewhat, and having an idea that it was finished the previous day I went to see what was up. I found the keyseats had been cut in the wrong places, and that an attempt was being made to fake this up. The keys, which had already been fitted, had been thinned down until they were flush with the shaft, then drilled and countersunk, to receive taper-headed screws. The shaft also had been drilled and tapped and the thinned keys were in the course of being driven in and screwed down preparatory to being filed off flush with the shaft. All the time this was being done, a laborer was kept on the lookout for the boss, who if he came anywhere near the job, was promptly carried off by the foreman to look at something particular at the other side of the shop. Meanwhile bags would be tied around the shaft, ostensibly to keep it from being bruised. When the faking was finished the job had to go through the whole original performance again, new keys, new keyseats, fresh fitting and (Pessimist, a word in your ear) the time was booked on another job and the boss never knew anything about it. Is it necessary to state that this was the foreman's mistake, he having given wrong orders, and by the way, would you believe that the next day, he discharged the man that turned the shaft, because a pulley didn't drive quite as hard as he wanted it? But of course the boss heard of that.

Pessimist desired the experience of other men, *re* worthless or wasteful work, I give these instances to indicate where definite leakages are to be found. It is easy to see that the foreman who is too

fond of polish is likely to cause as much worthless work as the careless one, who, in giving wrong orders, causes worthless work to be done. They are both forms of incompetency and when one remembers that what the foreman is the men are likely to become, it is plain to see that the wasteful or careless foreman is a loss in more ways than one. In the cases mentioned, if there had been a little more deliberation and discrimination shown, these mistakes would not have happened, and what is true of one shop is true of many, at least, such is the experience of

London. A MERE TURNER.

Permitting Visitors in the Shop

For my part, I don't see why a fellow should not do as he likes about it; especially if it's his own shop. I know that I should want to feel free to keep people out of mine, if I had one. However, I have seldom missed an opportunity to see any place where visitors were admitted, so that it would hardly be fair to refuse to return the favor without very good reason. Provided a man were consistent in staying away from other shops, even when attending meetings of engineering societies, he could exclude visitors with the clearest of consciences.

Probably even he would admit a few people who were not on the pay-roll, such as government inspectors, or his wife's aunt who wants to see what a real machine shop is like, or a customer, or perhaps even the fellow who wants to "write-up" a few machine operations for a technical paper.

THE PRACTICE IN ENGLAND

When it comes to the idly curious, the matter is very different; they are, if any, the people to be kept out. In England, they tell you, as they did me at the Armstrong-Whitworth works last summer, that it is customary to present a letter of introduction. When I asked the decidedly serious, though courteous, employee if the chances would be good in that case he gravely informed me that permission *was* sometimes granted. I did not get a letter, so did not see the place. Why could not that method be used over here, to at least reduce the number of visitors if they became a nuisance? The burden of proof rests with the visitor, who bears all the expense of time and trouble. Here in America, the mere necessity for an introduction would keep a great many away, even of those who could obtain one.

THE COST OF ADMITTING VISITORS

The really serious objection to allowing strangers in a shop, is the expense involved. If a guide is sent with them, there is, of course, his time to be considered, while if they are permitted to wander around alone, conversations and even the transaction of private business with the workmen will reduce the output somewhat. Then there is the possibility of their damaging the work or machinery or of injuring themselves.

It is said that a carpet firm refused to show visitors the sewing room, where a hundred or more women were sewing the seams, offering as an explanation, that they had calculated a loss of several dollars each time the room full of workers stopped long enough to satisfy their curiosity about a visitor. This appears to be an extreme case, similar to the shop where nothing but ground glass was used in the windows, to prevent time being lost gazing at the "view."

Even a foreman may look at the matter from a peculiar standpoint: A boy, selling newspapers late in the afternoon, was kept out of the building when his regular visits were discovered. One foreman complained that it was "an outrage." The boy came to deliver *his* paper at *his* request. To be sure, the boy made the circuit of *his* shop and sold papers to perhaps half the men, after they had looked the headlines over and hunted up the necessary change. Then the latest news had to receive more or less discussion at a time when the working pressure was at its lowest, but it was "an outrage" just the same.

THE ADVERTISING VALUE

Admitting that customers may be shown the shops with advantage to the firm, it appears self evident that no one should be turned away, if, by any possibility, he might become a customer. In the case of such manufactures as shoes or breakfast food, this means that every man, woman and child should receive a cordial reception. It would certainly be strange if such an opportunity could not be made to yield greater results for an equal outlay than advertising of any other kind. Not that it could replace the other forms, but that it can so easily be made a strong factor in the system.

Just think of it; here are people taking the time and trouble, possibly going to the extent of an actual cash outlay, to put themselves in the best possible position to be convinced of the superiority of your goods. *Interested?* of course they are interested; that's the reason they came. Did you ever watch the crowd around *any* exhibit of *moving* machinery? Most of them could not make their attention wander if they wished, the surroundings are too absorbing.

A little explanation of the principal processes, drawing attention to the accuracy of the work or the cleanliness observed, often leaves the visitor with the impression, unfounded though it is, that other manufacturers fail in those particulars and so fail to make a product equally good. Often a few statistics are added, such as the number of times the annual output placed end to end would encircle the earth. If many of these people depart with the facts presented so as to appeal to their imaginations and stick in their memories, they are certain to relate their adventures to friends and so start an advertising chain which will prove self-expanding.

Where the customers are confined to a narrow class there is no logical reason that I can discover why the public should be admitted. The large breweries in Milwaukee are striking examples of the policy of admitting the public, even on Sunday when no work is in progress.

A SENSIBLE WAY TO HANDLE A LARGE CROWD OF VISITORS

This problem of dealing with a large number of visitors daily, is, I think, solved most satisfactorily in rather an ingenious way by the Lever Bros., in their soap factory at Port Sunlight, England. While in Liverpool for a few hours, I took the opportunity of seeing Port Sunlight, the famous model workman's village, and found it very interesting and apparently all that is claimed for it. Of course, the people may be overgoverned as were those in the model town of Pullman at one time, but the newspapers blowing around in some of the dooryards and the unique collection of chicken coops in the garden plots did not indicate that stereotyped forms were insisted upon.

The charm of the streets and houses was in striking contrast to the usual manufacturing neighborhood in that part of England. Those who have not seen them can scarcely appreciate the difference. The average English workman is said to drink to excess, but his environment would probably have the same effect on some of the rest of us.

One strange thing, which was very noticeable, was the number of people, evidently strangers, many of them workmen from other towns, who had come to see the factory and village as they might a fair. Following some of them to the main entrance to the works, we passed into a large vestibule, well filled with visitors and many cases filled with samples of the soap. Soon a uniformed attendant led us through one of the general offices to a narrow stairway, where he remained after supplying everyone with an illustrated, "Souvenir of Port Sunlight," which gave a very good idea of the town as well as the factory and its product. Someone made the remark, after looking it through, that all the soap usually seen in England was made at Port Sunlight. There was certainly a great variety, intended for all purposes.

The stairs turned into a covered passage built over the roofs of the one-story buildings, until it entered the printing building, where it was supported on the lower members of the roof trusses. From there, after passing the length of the long room, it led by twists and short stairways through several of the principal departments, the "soapery," cooling and packing rooms, etc. Evidently this was

only a portion of the whole plant, selected to give an idea of the operations. This "visitors' gallery" was apparently constructed after the buildings, in such a way as to prevent the visitor leaving it, or coming in contact with the employees. It was about four feet wide, railed usually on both sides and so high up under the roof that the constant stream of people on it must have lost its novelty for the workers long before. Placards at intervals told what operations were in progress and the "Souvenir" when consulted proved an efficient member of the entertainment committee.

While most of the workers, who were largely girls, were very busily engaged, others appeared to be idle for a time, possibly for a rest interval, and talked and laughed in a way which indicated that they were inclined to look at the cheerful side of life.

Finally the stream of visitors was discharged into the street a block or more from the office, through a non-reversing turnstile which reached to the ceiling. The whole contrivance, in fact, reminded one of the glass-front mail chutes used in tall office buildings, and was a successful adaptation of them, into which the visitor was dropped and allowed as he passed along to see all he wished of things they were perfectly willing to have him see, where he was well out of harm's way and could neither escape nor do damage, and then they put a check valve on the end of the "pipe-line."

H. L. WHITTEMORE.

Foundry Costs

The man who is interested in improving the product of a factory and lessening the cost of production must know the exact cost of the parts he proposes to better and also the cost of each separate operation on these parts before he is in a position to say that betterment is possible.

This information can usually be obtained from the cost department with absolute accuracy for labor and material from every department of the plant except the foundry, but when we call for the exact cost of a certain casting we find ourselves up against a straight out and out guess, and this too in foundries melting from fifty to one hundred tons of iron daily.

THE QUESTION AT ISSUE

In changing a part from gray iron to steel, or steel and gray iron combined, it sometimes occurs that a reduction in weight of 25 to 30 per cent. is obtained, also a considerable increase in strength as well as a much neater and more mechanical appearance, and then after having accomplished these very desirable results, we find ourselves called upon to answer the sometimes very objectionable question, "Will the proposed improvement add to the cost of the machine, and if so, how much?" a very simple question indeed, but one of vital importance to the matter in hand and upon the answer depends the adoption or rejection of the improvement. Nor is it a matter of dollars, and sometimes not of cents, as a fraction of a cent in additional cost is often enough to cause serious opposition. Of course this looks very strange to a man in the engine, machine-tool, or kindred lines, where a few dollars extra cost on a machine for a good improvement meets with hearty approval, but it must be remembered that there are many other lines whose product is sold so closely that the only hope of the stockholders for future dividends lies in the savings to be made by improving the methods of production.

In such cases, and when from 10,000 to 100,000 or more of each part are required, it is obvious that a cent added to the cost of a part looks larger to the management than the proverbial cart wheel. It is, therefore, necessary that we should know the exact cost of the part used at present, and the closest possible estimate of the cost of the improved part before we would care to present the matter for consideration.

THE USUAL METHOD

As the first thing we need is the cost of the gray-iron casting in present use, we go to the head of the cost department and ask for every item of cost on this casting. In a short time we receive the list, and in it find the weight of the casting given as 100 pounds and a note saying that the cost of gray-iron castings, cleaned and delivered to the department where used, is two cents per pound. For all the other items, such as boring, facing, key seating, putting in set screws, painting, crating and shipping, the exact prices paid are given and there is no difficulty in finding the total cost, if we accept the two-cent rate for that casting; but this we cannot do, and, therefore, call up the cost accountant and ask if he can give a cost price on the melted iron and furnish the other cost items, such as molding, core making, cleaning and delivering, separately, as we do not feel satisfied with the two-cent rate, and must know the exact cost of that particular piece. Our answer is that they never figure it that way, but that they had some figures on the cost of the iron, which they estimate at one and two-tenths cents per pound.

TWO CASES COMPARED

The other items are readily obtained and we start for the foundry to look over the ground. We find the pattern on a molding machine and two men on the floor putting up sixty flasks a day, one piece in a flask, and receiving ten cents for each casting. In this case the actual cost of molding alone is one-tenth of a cent a pound.

We next stop at a snap bench and find a card of twelve patterns, each weighing one and one-third ounces. The molder is using a squeezer and putting up one hundred molds a day, for which he receives three cents a mold. The actual cost of molding this piece is seen to be three cents a pound, or thirty times more than the cost of molding the casting we are looking up.

These two cases should convince anyone of the utter unreliability of this method of fixing a cost price on castings of various weights and sizes; it may do well enough for obtaining the cost of all castings produced, but is absolutely useless for finding the cost of any single casting.

Had we taken the two-cent rate as final in this particular case we would have shown a profit in favor of the steel construction of twenty cents, but when taking the rate of one and two-tenths cents for melted iron and figuring in every other item of cost, and making liberal allowances for the tools used, we were able to show a profit of but two cents, and had the satisfaction of knowing that it was as nearly an honest comparison as could be obtained under the circumstances.

It is certainly astonishing to notice the prevalence of this poorest of all poor methods of estimating the cost of castings. In my opinion, it is just as essential that the actual cost of each separate casting should be known, as it is that the cost of boring, turning, facing and key seating that same casting should be obtainable.

THE PROPER BASIS OF FOUNDRY COSTS

If the fixed foundry charges were placed upon the melted iron instead of the finished product, it would be a comparatively easy matter to find the actual cost of any casting. These charges would include the rental of buildings, power, salaries of foremen, pro rata of expenses of superintendents and general offices, also all labor pertaining to cupolas and all material used. In this way we could obtain a cost price per pound of metal that would be fair to every casting in the shop. The rest would be easy; each piece having a known cost for molding, core making and cleaning, the expense of patterns, flasks, molding machines and their repairs and renewals, and other charges pertaining directly to each particular casting could be readily estimated and apportioned. Then the cost of each casting as well as the labor on it would appear in the records of the cost department to the great advantage of all concerned.

NEW YORKER.

The term "smoke graphite" has been used in describing the material from which somebody's chain lubricant is made. It is possible that by this is meant lampblack, which is deposited by smoke. According to *Graphite*, lampblack is not a lubricant at all.

Congress and the Patent Office

We have referred to the report of the commissioner of patents and his statement to the effect that the salaries now paid to examiners are too small to enable the office to hold men who have become efficient. For obvious reasons, however, such an official as the commissioner is debarred from discussing some phases of the question which nevertheless have an important bearing upon the matter.

Experienced patent practitioners are more free, however, and Park Benjamin, in a letter recently published in *The Evening Post*, goes into these questions and says:

The conditions in the patent office are little different in kind from what they have been for the last quarter century. Every patent attorney and every patentee of experience fully understands them. Every commissioner of patents in every annual report has with more or less emphasis protested against them. Over and over again the facts have been pressed upon Congress, and occasionally some small measure of relief has been obtained. But at no time has that body been willing to devote from the ample surplus now lying in the treasury to the credit of the patent office and paid by the inventors and patentees for service not rendered a suitable amount to meet the fundamental difficulties of inadequacy of force, inadequacy of pay, and inadequacy of the most ordinary and necessary facilities for carrying on the work. The patent office is netting a profit to the extent of something over $270,000 a year. Unless it is to be regarded as an institution for enabling the rest of the community to make money out of one particular class, this surplus is simply filched, mainly out of the pockets of the inventors upon whose work nine-tenths of the industries of this country depend.

The particular exacerbation now is the extreme delay in acting on filed applications. For some years past the patent office has been little else than a law school. A boy goes in there under a mild civil service examination and stays until he thinks he knows enough to start practice as a patent attorney for himself. If he shows any particular ability his chances of offer of employment in the "patent department" of some big industrial concern at a much higher salary are good.

As the best men are constantly drained from the patent office, because the Government is steadily outbid by the private employer, the residuum of the examining corps is composed of the "green" learners and the old officials who have been too long in the harness to be willing to face the world. A principal examiner is paid $2500 a year. If he has the capacity for the sort of work he has to do, his earning power outside ought to be three or four times that amount. The position is a very responsible one and should command at least $5000 per year, and the salaries of the assistants should be proportionately increased.

The working force is about one-half what it should be. There are no digests of the granted patents. An applicant cannot find out for himself what is new and what old, except at an excessive expense. If he could do so at moderate cost in advance of making his application, a large percentage of the official work of examination would be saved.

The statements that the office is catching up with its work—disposing of so many extra cases a week, etc.—does not tell the whole story. It is quite true that more "actions" are being made, but what actions? So far as my observation goes, eight out of ten are in persistent disregard and violation of the rule which requires the examiner to give *his reasons* for his decisions. That would take time. He contents himself with making rejections or objections on a string of earlier patents noted merely by number and date, leaving the applicant to find out what they have to do with the invention best way he can. Sometimes he rejects on one old patent "in view of" another old patent, or several of them, and then the guessing capacity of the applicant is still further taxed to imagine what "view" is revealing itself to the hidden recesses of the official mind. It will easily be understood that the present vigorous application of the prod, coupled with "keeping in" the school until five o'clock every day, is more conducive to quick decisions than to particularly thoughtful ones, and besides as every "action" counts as progress, we are also getting some that are rather amusing. For example, on an application involving an invention of the first rank an action was received the other day as follows:

"A comma (,) should be inserted after the word 'lever,' line 11 of page 1. The case appears to be otherwise allowable."

The addition of the comma could not possibly affect the sense. But here was an "action" to be credited as progress. It delayed the case about three weeks.

We are also now getting the "actions" of the young gentlemen admitted last July. Attorneys who were in practice before these jurists were born silently hand copies of them to the applicants, and the applicants' criticisms are seldom printable.

Of course, all this throws more work on the attorneys and more expense on the applicants. One can protest, and have an examiner's action reviewed by the commissioner, but that means only still more delay and still more expense.

The present commissioner is in very much the position of the organist in the Western church, at whom the congregation was requested not to shoot "because he is doing the best he can." He is a very capable man—one of the ablest we have ever had in the patent office. He has been there longer than any previous incumbent, and he has stayed there *con amore*, for the miserable pay is of no importance to him. If Congress would do what is glaringly necessary, no one better able than he to reorganize the office on the new basis could probably be found. But the responsibility is squarely on Congress, and the only hope of relief is a steady onslaught on that body by the people who are directly suffering from its persistent and inexcusable neglect.

Sale of Cassier's Magazine—H. H. Suplee Its Editor

Cassier's Magazine has been sold by the estate of the late Louis Cassier to Henry Harrison Suplee, for many years the technical editor of the *Engineering Magazine*, and James Van Vorst Colwell, recently works manager for the C. W. Hunt Company, and the publication will be continued as heretofore by the Cassier Magazine Company, at No. 3 West Twenty-ninth street, New York. The editorial conduct of the magazine will be in the hands of Mr. Suplee, who brings to this work a wide experience both in the practice of mechanical engineering and of technical journalism, while the business department will be directed by Mr. Colwell. The first issue of the magazine, under the new management, will be the January number.

F. H. Stillman, of the firm of Watson & Stillman, has been in negotiation with the managers of the new office building of the Hudson Companies, which is to be above the terminal station of the New Jersey tunnel to New York, on behalf of machinery interests generally, and a letter has been addressed to those machinery concerns who have representatives attending the meeting of the American Society of Mechanical Engineers, asking them to attend a meeting on Thursday afternoon, December 6, at 3 o'clock, in the rooms of the New York Board of Trade and Transportation to consider the matter.

The annual meeting of the National Civic Federation will be held in the assembly room of the Park Avenue hotel, New York City, December 12-13. The special subjects to be discussed will be the income tax, government by injunction, and child labor. Eminent speakers are expected to be present and take part in the discussion of these and other subjects.

Electricity is playing an important part in the construction of the Porfirio Diaz tunnel in Guanajuato, Mexico; the air compressors for the rock drills are run by 50-horse-power Westinghouse motors; the ventilating fans are run by motors and the hoist for hauling out the loaded cars is also electrically operated. The power is furnished by the Guanajuato Power and Electric Company.

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Government Participation in International Expositions

A feature of international exhibitions has to do with government participation in them. There are usually more or less politics and questions of influence, etc., that have to be reckoned with. It seems there has been some unsatisfactory work in this connection in Great Britain, and this has led to the appointment of a Board of Trade committee to make inquiry into the whole question. It is expected that this committee will have authority to make at least a fairly comprehensive investigation, so that its report may reveal proceedings in connection with recent exhibitions, which proceedings have not been entirely satisfactory. The terms of the appointment are as follows:

"To inquire and report as to the nature and extent of the benefit accruing to British arts, industries, and trade from the participation of this country in great international exhibitions; whether the results have been such as to warrant his Majesty's Government in giving financial support to similar exhibitions in future; and, if so, what steps, if any, are desirable in order to secure the maximum advantage from any public money expended on this object."

It would seem to be a good idea if some competent committee or board could be appointed to investigate this question on behalf of the United States Government, and help in arriving at a decision as to the wisdom or unwisdom of participation in such exhibitions and if we are to participate then how we may do it to the best advantage.

The Engineer in Business and in Public Life

That the engineer is more and more in evidence as a business man, or as a business executive, is constantly made apparent, and some interesting and instructive comparisons are made between organizations in which engineers have something to say as to how things go, and others in which they have little or nothing to say.

Among railroads, for instance, some contrasts can be drawn, which show with exceeding clearness the effect upon character of service and general management of the policy upon one hand, of promoting engineers to positions of executive responsibility, and upon the other of promoting to such places only those who have come up through the business end of the organization. This is upon the assumption of equal intrinsic ability and equal honesty of purpose and devotion to business.

Another phase of the matter is interestingly discussed by our contemporary, *The Engineering Record*, in an article in which occurs the following passage:

"The slogan of 'business is business,' which, in its simplest meaning, is a mere statement of the non-altruistic nature of ordinary commercial operations, means, unhappily, all things to all men—to each what his individual code of morality and honor implies—to one mere straightforward, unsentimental dealing with his fellows, to another anything which escapes the direct grasp of the criminal code. Now from the point of view of this journal, the strength of the engineer as a business man lies in the fact that his training enables him to cope with technical difficulties, and has taught him not to dodge or shuffle with the truth about the matter in hand.

"Some one whimsically defined an engineer as a fellow who could do for fifty cents what any fool could do for a dollar. Following out this definition, it is necessary to add that the engineer does this by more skilful use of material resources, and not merely by scamping the thing just fifty per cent. And it is because the larger minds in business realize that, in the long run, honesty is the best policy, that they are advancing engineers to important administrative work. No man who expects to get on by making fraudulent goods has much use for men who are trained to make merely economical use of suitable materials. The engineer has the advantage, if properly trained, of knowing not only how to do this, but also what materials are necessary to be used, and what is the inferior limit of their cost in any given case. He therefore stands for construction that embodies maximum economy for given specifications, and if he is honest with himself, would reach exactly the same physical conclusions whether he were working for the manufacturer or the user. And to the credit of the engineering profession, be it said that the engineer is usually conscientious in his conclusions for whomsoever they are drawn. There are, of course, crooked men in every profession; but one who is trained to look facts squarely in the face is on the whole less likely to go wrong than one who has been schooled in evading facts.

"Whatever superstructures of fraud may be evident in business, upon the whole there is a substratum of honesty upon which honest building can be, and is, done. The engineer, as a citizen, has the advantage of knowing the difference, and he is thereby fitted to act upon matters in which the difference between fraud and honesty is important. What his view may be upon current economic questions is neither here nor there, so long as it does not warp his professional conduct. Society, as a whole, has an ethical basis of conduct founded, in the last analysis, upon self-preservation. Part of this is codified into laws which, if lived up to, make for general good conduct. A part cannot be so codified, but is none the less important, since it derives its just powers from the same fundamental principle. Whoever, living in human society, transgresses either part, deserves no sympathy if he comes to grief.

That which conflicts with common welfare may excuse itself to itself on the ground of an individual freedom, which is seldom invoked, save as an excuse for wrongdoing; but it will none the less pay the penalty sooner or later. Hence, the engineer as an engineer is not charged with any special duties in defending or attacking the existing status. If he does his professional duty, looking neither to the right nor the left, his influence will be steadily thrown on the side of that common honesty, which in the long run will win out."

As to whether or not the engineer is charged with any special duties in relation to civic matters, opinions will differ. Every American citizen is charged with a certain responsibility for the conduct of public affairs. It is the duty of every citizen to discharge this obligation to the extent of his ability. If the engineer, by reason of his training in the way of looking facts squarely in the face, and of dealing honestly with them, is especially well fitted for administrative duties in business, then probably he is by the same token specially well fitted for public administrative duties, and has corresponding responsibility. And this responsibility is certainly not diminished by the fact that the engineer's work, speaking broadly, has a far more profound effect and influence upon social life than that of any other man; and in saying this, we do not in these days have to except even the soldier.

As to the Non-delivery of Papers

A machine-tool manufacturer in whose shop some little trouble had arisen about the failure of certain subscribers to receive their copies of the AMERICAN MACHINIST regularly, was looking through our mailing system recently, and finally said he, "It seems to me it is deficient; you ought to have some means of knowing in every case whether a paper has been delivered or not." "Well," said his guide, "What do you do when you ship a machine tool, for instance? Do you keep track of it to see whether or not it arrives at its destination, or do you, after you have shipped the tool and received the bill of lading wait to hear from your customer, in case it fails to arrive." "Why," he said, "We wait to hear from our customer." "Well," said the guide, "That is what we are obliged to do, because we know of no better way. If one of our subscribers fails to receive his paper on time, we have no way of knowing that unless he makes a complaint, and if you think it is impracticable for you to follow up your shipments, which average about two a week, to see that they reach their destination and on time, what do you think we could do with shipments which average from this establishment about 36,000 per week?"

NEW TOOLS AND MACHINE SHOP APPLIANCES

A PUNCH AND A SHEAR

The illustrations, in Figs. 1 and 2, show respectively a heavy vertical lever punch and a heavy shear of the same type. These machines are especially adapted for the use of ship yards and structural shops as there is no overhead gearing on them

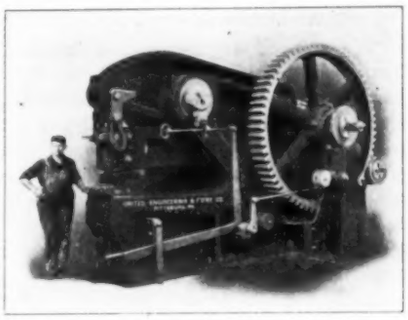

FIG. 1. A PUNCH

to interfere with traveling crane, chains, etc. The design is also such that the operator can stand close up to his work and has better control of his machine. These tools are of the English type, about the first of these built in this country having been supplied to the Great Lakes Engineering Works, Detroit, Mich. The levers, gearing, brackets, etc., are steel castings, while the main housing is of cast iron. All shafting, pins, etc., are of forged steel, while most of the bearings and the sliding heads are brass bushed.

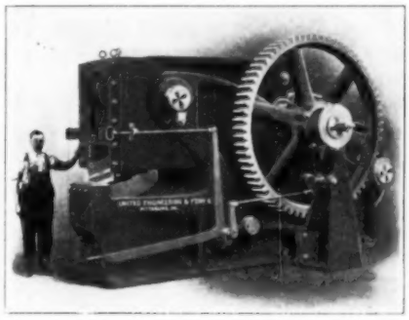

FIG. 2. A PLATE SHEAR

The punch illustrated will punch a 1½-inch hole through 1½-inch plate. The shear will cut 1½-inch plate. The shear blades are 24 inches long. The machines weigh 70,000 pounds each, and are built by the United Engineering and Foundry Company, Pittsburg, Penn.

A FOUNDRY SIEVE

The rim of this sieve is made of bent wood in two parts, one telescoping within the other and reinforcing the sieve at the bottom where the operator jars it against the trough. The two parts are bound together with hoop iron. The sieve is called the "Rockwell Riddle" and is made by S. Obermayer Company, Cincinnati, Ohio.

An English Naval Repair Ship

Doubtless many of our readers will remember that we gave an illustrated account of the U. S. Navy repair ship "Vulcan," which was equipped and put in service during the Spanish war, and which rendered such valuable service as a floating naval repair shop. We have also noted in previous issues that the British Government has taken up this idea, and we find described in a recent issue of a British contemporary a very complete vessel along these lines. Our contemporary, *The Mechanical Engineer*, says:

"About a couple of years ago, it will be remembered, an old cruiser was specially converted and equipped to act as a floating workshop to attend on the fleet at sea for the execution of repairs, the idea being, if we remember rightly, copied from the U. S. Navy, who demonstrated the practical value of a vessel of this kind during the war with Spain. The experience with this vessel, which was appropriately named the "Vulcan," has been so encouraging that the Admiralty decided to carry the idea a great deal further, and some months ago a vessel was quietly launched which now bears the name of "Cyclops," and is being equipped at Sunderland in such a way that she will, when completed, be practically a floating naval workshop, capable of executing the most extensive repairs to engines and machinery when out at sea. A good deal of secrecy has been observed in respect to the vessel and its equipment, but this has not prevented a general description of the vessel and its equipment leaking out. According to a correspondent her dimensions are: Length, 460 ft.; breadth, 55 ft.; and depth, 40 ft. She has huge hatchways leading to decks below almost for her full depth. At the lowest level is a fully equipped foundry, with cupolas, where damaged parts of machinery can be replaced by new castings. The capacity of the foundry is adequate to deal with moderate-sized castings. On a higher deck is a boiler shop, where boiler and ship plates can be dealt with, and where there are shearing and punching machines just the same as in a shipyard. Then there are carpenters,' blacksmiths', and armorers' shops, fully equipped fitting works, and electricians' and coppersmiths' departments. There is a crane which travels all round the ship, to lift the repairs to and from the works below. The vessel has a large ice-making plant, and a set of gigantic condensers capable, if need be, of supplying a fleet with fresh water. All the machines and cranes are to be worked by electric motors, and the vessel will be fitted with a wireless telegraph apparatus."

It is stated that the first gas engines employed for furnishing the blast for bessemer converters are those installed at the Rombach Works, Lorraine, in January. Their performance has been satisfactory.

UNJUST CLAIMS UPON BUILDERS OF MACHINE TOOLS

At a meeting which took place some time ago where there were a number of machine-tool builders present, the subject of unjust claims which are made upon tool builders for alleged defects or failures to meet requirements came up for discussion and one tool builder present in giving his experience along this line said:

"Every machine-tool manufacturer has had many claims made upon him for defective work or material or inefficient performance of his machine which claims were entirely unjust, and upon the investigation of which he has spent much money. If we could adopt some method to materially reduce these charges and losses, we would be adding just that much profit to our year's business.

A LATHE SPINDLE RUINED

"The day after one of our best agents had delivered one of our lathes to a customer, the agent received a telephone call of a peremptory nature demanding that someone inspect the lathe and find out what was the matter with it. Fortunately, a competent man was sent, and he soon found that the large face plate was appreciably out. The natural conclusion was that the purchaser had had it off and gotten some dirt into the thread of the face plate, and, in screwing it back, had thus gotten it out of true. However, the suggestion that the face plate be removed was most strenuously combatted, the first statement being that it was impossible. Nevertheless, it was removed, and the nose of the spindle showed most horrible abuse. It then developed that the so called mechanic had taken a 36-inch pipe wrench and gripped it onto the nose of the spindle, resting the wrench on the shears of the bed, and then had thrown on the power, his object being, as he said, to take this thread off; he supposing that this was a false nose and that the real one on the spindle was smaller in diameter, onto which he proposed to fit a chuck. Fortunately, the driving belt broke.

"In this case the salesman requested the proprietor to inspect the machine, the true state of the case was shown him, and, we judge, summary dismissal was the reward of the supposed lathe man. However, had there not been a competent representative on the ground to investigate the matter, doubtless the lathe would have been shipped back and we would have suffered not only in the matter of expense, but in reputation as well.

AN ELASTIC FOUNDATION

"A concern having a really capable manager complained of a lathe as 'out of line.' The man we sent found the lathe standing on a newly laid asphalt floor. His first stipulation was that he be allowed to cut away all that beautiful new asphalt down to the concrete. He met an absolute refusal, but his ultimatum to the effect that as long as the lathe was to stand on the asphalt he would not touch it, finally brought results and the trick was quickly turned. We were absolutely blameless in the matter, but it cost us $75 to prove it.

AN ACCIDENT CONCEALED

"We shipped a lathe valued at about $900 to a certain company not far from our city, who, soon after receiving it, made a vigorous criticism that it did not work satisfactorily. We sent a man who put the lathe in order and left it running to the satisfaction of the buyers. Incidentally he did a certain amount of questioning which developed the fact that the lathe had been dropped off a flat car in unloading it. As if by a miracle nothing was broken. The buyers took this method to have the lathe put in order without paying for it. The cost to us was probably $50.

THREE AND A FOURTH TIMES INSTEAD OF FOUR

"When we first went into business we sold a machine for $800 which was to turn out four times as much work as the machine then in use. The best it did in actual performance was about 3¼ times as much work. In view of this awful fact, the purchasers would not settle nor would they make any proposition of settlement and finally refused to answer letters. I made a trip of five hundred miles to their city to adjust this difficulty of a machine that would do only 3¼ times as much work as they were previously doing and was finally met with the remark: 'Young man, you've got your foot in it and you can get it out the best way you can.'

"Incipient legal proceedings brought a settlement promptly. While they were technically within their rights, the lack of equity and decency was so great that we have subsequently made it impossible for them to buy of us in spite of their many inquiries.

A GOOD LEVEL NEEDED

"A very large concern complained of a lathe being out of line. The suggestion that it had not been leveled properly was considered almost insulting. A competent man from the shop, with a good level, showed it to be out. Their superintendent was man enough to acknowledge in a letter that he alone was at fault, but had we sent his company a bill for traveling expenses and the man's time, amounting to $85, it would have placed him in such a position before the proprietors as to make it impossible for us to sell another lathe to him or his company.

"Another prominent company complained of a lathe as being 'out of line.' Our president being in that vicinity called upon them and found that the lathe sagged down out of line three-eighths of an inch to the solid floor and yet the old gray-whiskered "Super" did not think much of that. Another $75 gone.

A LATHE WRECKED AND TAKEN BACK

"We shipped a large lathe to a point about three thousand miles away. After having had serious complaint regarding its operation, and which we were unable to understand, we discovered that the lathe, which was an electrically driven one, had been in a train wreck and had been thrown into the ditch, but either the railroad company or the agent selling it had sent it to a shop and it had been 'done over.' The fact that we could get no evidence which would stand in a court of law pointed toward collusion between the agent, the railroad company and the customer. It finally resulted in our having to take the lathe back—a total loss to us in freight, etc., of about $600. You may be sure that, had we been able to establish our case in court, we would have resorted to this means to reimburse ourselves.

"As to curing these troubles: I think we should resolutely meet every claim by a prompt written response that we would do whatever was necessary to correct any trouble on condition that, if it is found that we are not to blame, the customer should pay the expenses involved, including the wages, traveling expenses, hotel bill, cost of material and any other legitimate expense incurred in connection with the repair.

"In event that the customer refused to accept this perfectly equitable proposition, and further declined to make settlement until the repairs were made, then the case should be stated in a dispassionate way to the proper officer of some association. In one year's time we would have a good line on the undesirable customers of the country, and there could be reports on the same plan that commercial agences issue their 'pink reports,' indicating that if further information was desired on a given party, it could be had on application."

There can be no doubt that this is a matter of considerable importance, and that it continues an important item in the cost of producing machine tools.

COST OF KEEPING MACHINES SOLD

It is well recognized that in certain lines of machinery it costs as much to keep the machines sold as to sell them.

In the case of a cream separator, for instance: This machine is made by the best makers, is a very refined piece of mechanism, which must run at exceedingly high speed, with a small consumption of power. It goes into the hands of farmers and dairymen, who are usually utterly unfamiliar with such machinery, and with the

methods apropriate to the handling of it. Such machines, returned to the factories for repairs, frequently show almost unbelievable abuse and ignorance on the part of their users and the only practicable way of handling the business is for competent and carefully trained local agents to go about among the users, tactfully instructing them, and setting them right where they have gone wrong.

All this costs money, but is a recognized element of cost. Its worst feature, perhaps, is that it must be covered in the price at which the machine is sold, and thus the intelligent and careful user pays just as much of it as the ignorant, careless and slovenly user.

Obviously, a fairer way would be to reduce the cost to all purchasers, and then in some way make the ignorant and careless ones pay all the expense made necessary by their ignorance and careiessness. But no practicable way of doing this has been devised, and probably the principal difficulties in doing it would be the same as that which our tool builder has encountered, i e., the ignorant and careless one will strenuously object to making any such payment, will "put up a howl," go to law, and otherwise make himself disagreeable.

Automobile manufacturers are "up against this" hard. Most of their machines go into the hands of men who know almost, if not quite, nothing about machinery, and who have a childlike faith in the word of the agent to the effect that the machine they are buying is practically unbreakable and of unlimited power and capacity. Automobile manufacturers do not at present suffer from this as much as they will later, when the ratio between demand and supply has altered a little; but for a long time this will be a large element of the cost of effective production of automobiles, i.e., the cost of placing them in the hands of buyers ready for use.

MACHINE TOOLS OUGHT TO BE DIFFERENT

In the case of machine tools, the situation ought to be, and of course is, essentially different. Machine tools are supposed to go mostly into the hands of men who are themselves builders of machinery, and who may be supposed to know how to handle it intelligently..

That tools are not always so handled is notorious. Added to the ordinary causes of ignorant and unskilled handling, we have in recent years the extraordinary demand for men which has led to the employment of many who, under ordinary conditions, would not be thought of as fit persons to be placed in charge of costly and refined machine tools. Then labor troubles, resulting in the handling of tools by dissatisfied union men, and by incompetent strike breakers, have added to the troubles of this nature.

ADVANTAGE TO ONE BUILDER. OF INTEREST TO ALL

While it is true that, if such abuses could be entirely done away with by any one builder, while his competitors continued to be burdened with them, then that particular builder would be so much the better off; yet if the economic law, according to which the consumer in the long run pays all necessary costs of production, is true, as we must believe it is, then it must be true that this feature of the business, affecting all, or nearly all builders, must be covered by the amounts that builders receive from their customers in payment for tools. And from this it follows again that those who set up and use tools intelligently, and who deal with the builders honestly and fairly, pay just as much of the cost of this feature of the business as do those whose ignorance, mismanagement, or dishonesty actually causes the trouble.

It is thus seen that, not only is it to the interest of a given builder to reduce this expense to the lowest possible limit, but it is to the interest of all buyers and users of tools to do the same thng.

DISCUSSION INVITED

The entire machinery interests are, therefore, vitally interested in this matter. It is a thing which may, we think, well be discussed, and we invite those of our readers and advertisers who have had experiences along this line to state them for the benefit of the trade generally, and to the end that this evil may be reduced as much as possible.

Personal.

L. A. Wyman has taken a position in the sales department of The Dayton Pneumatic Tool Company, with headquarters at Dayton, Ohio.

C. R. McGahey, who for the past two years has been superintendent of the Lombard Iron Works, Augusta, Georgia, has taken the position of general superintendent of the E. Van Winkle Machine Company, Atlanta, Georgia.

Boynton W. Piper, who has had charge of the metal-pattern department of the General Electric Company's works at Lynn, has resigned to become a partner in The Norfolk Machine Company, Hyde Park, Mass., manufacturers of metal patterns.

W. E. S. Dyer, formerly manager of the Reeves Engine Company, Philadelphia, Penn., has been appointed manager of the A. D. Granger Company's Philadelphia office, in the Commonwealth Building. Warren Peters will remain at this office with Mr. Dyer.

John MacGregor, formerly superintendent of the Pope Manufacturing Company, has established at Springfield, Mass., MacGregor's engineering agency, by means of which he will endeavor to bring employers and prospective employees together in the engineering line.

J. M. Felt, formerly superintendent of the Imperial Pneumatic Tool Company, Athens, Penn., has been appointed general superintendent of the Aurora Automatic Machine Company, Aurora, Ill. He succeeds Axel Levedahl, who resigned his position and went to California some weeks ago.

Obituary

William Fisher, inventor of many devices for steam pumps, died at Marshalltown, Iowa, November 29. He was 68 years old.

Edward M. McElmell, assistant engineer U. S. Navy, retired, died November 25 at his home in Philadelphia, Penn. He was a native of that city. He helped, under the direction of Rear Admiral Melville, to supervise the construction of several of the principal warships of the United States.

Chas. W. Lawrie, general manager of the Reeves Engine Company, Trenton, N. J., died at that place, October 25, 56 years old. Mr. Lawrie was a pioneer in the high-speed engine field. He was the inventor of an automatic governor, and for 10 years was superintendent of the Ball Engine Company, Erie, Penn.

Henry Davidson, a pioneer manufacturer of rules, and the inventor of the lock-jointed folding rule and square, died November 18 at his home in Brooklyn, N. Y. He was born in England in 1829. Until he retired, 17 years ago, Mr. Davidson was in business at Bowery and Hester street. He had been a resident of Brooklyn forty years.

Sir Edward J. Reed, formerly chief constructor of the British Navy and one of the most distinguished naval designers in Europe, died in London November 30 at the age of 76. He had designed vessels for various foreign fleets and was the author of a variety of works on shipbuilding. He was a vice-president of the Institute of Naval Architects and a member of the council of the Institute of Civil Engineers.

Government Telephony in Japan

It is stated that the Government telephone service in Japan is so in arrears as to its work, that while there is every incentive to supply as many customers as possible, the Government has so far found it impossible to keep even with the demand. In Tokio alone it is estimated that some four years will elapse before the Government will be able to supply an instrument to the last man who puts his name on the waiting list. Many candidates for service die before their turn comes.—*Electrical World and Engineer.*

This would seem to indicate that the demand for telephones in Japan is much more general and wide-spread than is the case in this country. Does this mean that the Japanese people generally are much

more prosperous and better able to afford telephones, or does it mean that the telephone charges are so much lower there that practically everyone can afford a telephone, and the service so good that he wants one? It would be interesting to have our contemporary go somewhat further into this matter.

Business Items

The Garden City Fan Company will remove its Chicago office from 42 South Clinton street to Suite 1217-1218 New Fisher Building, Dearborn street, between VanBuren and Jackson streets on or about December 1. The works of this company is at Niles, Michigan.

Manufacturers

The Mathews Manufacturing Company, ferrules, store trimmings, etc., Worcester, Mass., will erect a new factory.

James Ackroyd & Sons, Albany, N. Y., manufacturers of architectural sheet work, will build a new factory.

The Petroleum Iron Works, of Washington, Pa., has commenced the erection of a branch plant in Houston, Texas.

The American Machine and Typesetting Company has about completed plans for a plant in Springdale, Conn.

The Lattimer-Williams Manufacturing Company, Columbus, Ohio, will erect a large addition to its stove factory.

The La Belle Iron Works Company, Steubenville, Ohio, will build eight new sheet mills and two jobbing mills.

The American Building Block Company, of Lawrence, Kas., will erect a plant in Denver. About $250,000 will be spent.

The Brown & Sharpe Manufacturing Company has purchased a site in Chicago, Ill., on which a plant will be erected.

The William Ganschow Company, machinery manufacturers, Chicago, Ill., has bought site for a new factory building.

The Skinner Chuck Company, New Britain, Conn., has awarded contract for the construction of a new power plant.

The Mereen-Johnson Machine Company, Minneapolis, Minn., will enlarge its plant for the purpose of making its own castings.

The Adder Machine Company, Wilkesbarre, Pa., will enlarge its plant and start the manufacture of an improved typewriter.

The Alan Wood Iron and Steel Company, Norristown, Pa., it is said, will erect a mill for the manufacture of armor plate.

The United States Furnace and Foundry Company, of Darlington, Pa., is considering erecting a plant in Minneapolis, Minn.

The Carnegie Steel Company is erecting a new plate mill at Homestead, Pa., which will represent an outlay of about $1,000,000.

The Youngstown (Ohio) Foundry and Machine Company is trying to obtain some adjacent property for the extension of its plant.

The Co-operative Plate Ice Company, Baltimore, Md., has been incorporated and will erect a plant. Grant Stockham is president.

The East St. Louis and Suburban Railway Company has purchased a site in Belleville, Ill., on which a power station will be erected.

The Ericsson & Moon Manufacturing Company, Detroit, Mich., will build a three-story addition to extend the manufacture of marine motors.

Hutchison Bros., Victoria, B. C., machinists and electricians, have incorporated with a capitalization of $40,000 and will erect a new plant.

The Union Iron Works, Iola, Kan., has let contract for the construction of a new boiler shop, to cost $10,000, and equipment will cost another $10,000.

The Miners' Gas Engine and Manufacturing Company, Joplin, Mo., will put up a plant to manufacture a gas engine invented by L. L. Scott of that place.

The Associated Ice Company, Beverly, Mass., is having plans prepared for its artificial-ice plant. Maj. William Stopford, of Beverly, is interested.

The Reed Electrical Cordage Company, Syracuse, N. Y., will reorganize and increase its capital to $300,000. The plant will be enlarged and new machinery installed.

The Baltimore (Md.) Refrigerating and Heating Company is making plans for a number of improvements to its plant, which will involve the expenditure of over $50,000.

The Norfolk Machine Company, Hyde Park, Mass., has been organized as a partnership by J. W. Parker and Boynton W. Piper. They are equipping a shop and will make metal patterns and do experimental work.

The H. W. Johns-Manville Company is making arrangements for extensive improvements at its plant in Wauwatosa, Wis. These will consist of a refining building, roofing factory and an addition to the paper mill.

The American Locomotive Company will spend a quarter of a million dollars in improvements at the Richmond, Va., plant, which will include a factory for the manufacture of steam shovels and a new power plant.

The Little River Power Company has filed incorporation papers for the purpose of developing electric power on Little River, near Blanch, Ala. Capital $100,000. Incorporators, R. A. Mitchell, of Alabama City, O. R. Goldman, Gadsden, Ala., etc.

Catalogs

Buffalo Forge Company, Buffalo, N. Y. Leaflet illustrating and describing No. 200 geared hand blower.

Buffalo Forge Company, N. Y. Leaflet illustrating and describing leaders in blacksmith tools for 1907.

The Graham Manufacturing Co., Providence, R. I. Circular illustrating and describing piston-ring grinder for periphery.

The Berkshire Manufacturing Co., Whitney building, Cleveland, Ohio. Catalog of molding machines. Illustrated, 7½x10 inches, 23 pages, paper.

Westinghouse Traction Brake Co., Pittsburg, Pa. Bulletin illustrating and describing straight-air-brake equipments. 8x10½ inches, 12 pages.

Nernst Lamp Co., Pittsburg, Pa. Booklet telling something of the architecture of the new Pennsylvania terminal in New York and its lighting. Illustrated, 5x6 inches.

The Dwight Slate Machine Co., Hartford, Conn. 1907 catalog of sensitive drills, automatic pinion cutters, marking machines, etc. Illustrated, 4x6 inches, 115 pages, paper.

Wellman-Seaver-Morgan Co., Cleveland, O. Booklet, entitled "What we do in Iron and Steel Works Machinery, Ore and Coal Handling Machinery, Cranes, etc." Illustrated, 4x9 inches, 24 pages, paper.

The Bristol Co., Waterbury, Conn. Catalog No. 44, which describes recording gages, including portable recording pressure gages, and a number of new range gages. New charts are shown. Illustrated, 8x11 inches, 28 pages, paper.

General Electric Co., Schenectady, N. Y. Bulletin No. 4465, illustrating and describing trolley frogs. 8x10½ inches, 8 pages. Bulletin No. 4467, illustrating and describing emergency straight air-brake system. 8x10½ inches, 8 pages.

Hammacher, Schlemmer & Co., Fourth avenue and Thirteenth street, New York. Catalog No. 310, describing high grade woodworking tools in sets, tourist autokit in leather and canvas roll. Illustrated, 5½x7½ inches, 39 pages, paper.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

See my ad. page 168. H. A. Lowe.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Cox Computers. 75 Broad St., New York.

Wanted—Medium-weight specialties to build. Box 326, AMERICAN MACHINIST.

Wanted—A stamping press with a 5" strike. Powers, 343 East 63d St., N. Y. City.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Wire and sheet-metal-working machinery and tools. Emmons Collins, Chicago, Ill.

Working drawings, experimental work. Geo. M. Mayer, 1131 Monadnock Bldg., Chicago, Ill.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

Novelty in tool or machine specialty wanted. Particulars required. Box 202, AMER. MACH.

Special machinery designed and built. Walter S. McKinney, M. E., 43 Broadway, Flushing, N. Y.

Gas engines designed to order. Marine and automobile work a specialty. H. L. Towle, 150 Nassau street, New York.

Reference slips for runnerless slide rule, second edition, 10 cents. F. F. Nickel, 27 Winans St., East Orange, N. J.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Special machinery to order. Catalog of small engines and boilers and engine castings 10c. Sipp Elec. & Mach. Co., Paterson, N. J.

Working drawings and tracings carefully made by experienced draftsman; terms moderate. Address Box 378, AMER. MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Buyers of brass goods—Before placing orders see us for prices of castings and finished product. Good workmanship, prompt deliveries. S. J. Asbell Co., Paterson, N. J.

Boston manufacturers' agent wishes to represent established firm in this vicinity; will take on first-class line on commission basis. Address Box 367, AMER. MACHINIST.

Special high-grade machinery built to order, automatic and otherwise; electrical work a specialty. Complete modern equipment. Automatic Machine Development Company, 130 East 12th street, New York.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Among the employers who secure technical men through us are many leading contractors, engineers, railroads, etc.; some of them need men *now* for responsible positions. Write us today; service strictly confidential. Hapgood's, 305 Broadway, N. Y.

Contract work — A large, well equipped foundry and machine shop in Ohio is open for contract work; moderately heavy work preferred, such as machine tools, engines, compressors, or any special machinery. Address Box 370, AMERICAN MACHINIST.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

We have a modern up-to-date manufacturing plant and, having recently more than doubled our capacity, are in a position to take contracts for the manufacture of special tools, small high-grade machinery, or parts of machines in large and small quantities; we

can refer you to a very well known line of high-grade tools now on the market to demonstrate that we are able to do the highest grade of interchangeable work. Will be pleased to furnish estimates upon receipt of drawings and specifications. Box 363, AM. M.

Business Opportunities

Wanted—Toolmaker capabe of getting up new tools, and willing to take stock in business. E. G. Smith Co., Columbia, Pa.

Wanted—Ten or 12-foot vertical boring mill with two heads; tool must be in good condition and ready for service at once. Give lowest price and description to Electric Machinery Co., Minneapolis, Minn.

Wanted to contract with shop within 50 miles of New York City, equipped for making highest grade automobile chassis. Must have capacity for at least 100 cars per year and able to do highest grade interchangeable work cheaply. No body work. Box 210, AM. MACH.

British agency—A firm of engineers, with works and warehouses in west of England, London offices and agents throughout Great Britain and Ireland, are open to accept sole agency for American specialties in engineers' tools, etc. Address Frederick Avens & Co., "Trusty" Engineering Works, Stroud, Glos., England.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

I have $10,000 to $15,000 I will invest in a manufacturing business, preferably the machinery line, located in Boston or vicinity; will consider propositions only from men of high standing who desire this additional capital for improvements or enlargement of present business, and in return wish an interest of $2000 to $3500. No triflers, no schemers, no brokers. Replies will be considered in strict confidence. Box 391, AMER. MACH.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Two second-hand cupolas in first-class condition; shells 72″—82″ in diameter and about 40 feet high. Box 333, AM. MACH.

For Sale—AMERICAN MACHINIST from January, 1896, to December, 1904, 18 volumes bound in canvas. J. P. Mills, 40 Lockwood avenue, Cleveland, O.

For Sale—Four new extra heavy and well made gasolene engines; can readily be used for gas; price $150. These cost $275 each. One new No. 3 Goulds rotary pump, 5-inch suction, $90; cost $135. Geo. Gorton Machine Co., Racine, Wis.

For Sale—One No. 2 Aurora plain back-geared dividing-head milling machine in first-class condition; also one 38″x12′ screw-cutting lathe, manufactured by E. Harrington & Son, Philadelphia, in first-class condition. Box 351, AMERICAN MACHINIST.

An enterprising foundryman and machinist with capital, who desires to own and manage a good business in the most promising of young Western cities, will be fully repaid by writing F. Glenn, Lewiston, Idaho. Splendid inducements offered capable parties. Box 385, AMERICAN MACHINIST.

For Sale—An engine-manufacturing plant, doing a large jobbing machine business also; good buildings, with engine and boiler house; and stable, large lot, and railroad siding; complete outfit of machinery; old established business; location, eastern Pennsylvania. Box 394, AMER CAN MACH NIST.

For Sale—One new 9 h.p. portable Hornsby-Akroyd oil engine air-compressing outfit complete with water-cooling apparatus, air receiver and all accessories; price f.o.b. New York, $1100. This is an absolutely new outfit and cannot be duplicated for less than $1500. Box 379, AMERICAN MACHINIST.

For Sale—F.o.b. Ardmore, Pa., spot cash, the following machinery purchased last May and in use only three months, practically new: One No. 3 Hendey oscillating milling machine; one 12″x4′ bed automatic threading lathe (Automatic Machine Co., Bridgeport, Conn.); two 20″ Hamilton drills, back geared, angle drive, auto. stop, wheel and lever feed. Box 390, AMERICAN MACHINIST.

Foundry and machine shop for sale, with good will, in the northeastern part of Philadelphia; plant now running and is complete with core shop, engine, rattlers and cupola, with capacity for 5-ton heats; area of property 12,000 sq. ft.; streets on two sides; good local jobbing trade; owners consolidating plants elsewhere. Full particulars may be obtained by addressing Box 380, AM. MCH.

For Sale—Foundry and machine shop, electric, fully equipped; cost $108,000 to erect and equip; acquired upon debt; title good; centrally located; lies between two railroads; paved streets, electric lines, sewers, city water; solidly built of brick, fire-proof pattern storage, etc. A snap bargain. A portion of purchase price down, balance in deferred payments. Address The City Bank, Battle Creek, Michigan.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CALIFORNIA.

Mechanical engineer—expert on steam engines, marine and stationary, and air-compressor designing, erecting and testing—desires to change; 10 years' shop and drafting-room experience; Eastern States preferred. Repy to P. O. Box 299, San Francisco, Cal.

CONNECTICUT

Inventor (33), now employed, wants to change; typewriter or similar work preferred. Box 329, AMERICAN MACHINIST.

ILLINOIS

Draftsman, engineer, graduate M. E., employed, age 30; some shop practice and nine years' experience designing special machinery, instruments, typewriters, tools and fixtures for interchangeable parts, etc.; able, inventive man; will accept position as chief draftsman, leading designer, assistant to superintendent, or the like; location immaterial. Box 393, AMERICAN MACHINIST.

IOWA.

Mechanical engineer wants to get charge of a line of work with good people; $1600. Box 387, AMERICAN MACHINIST.

NEW JERSEY

Mechanical draftsman and designer, 28, college graduate, with eight years' practical experience on tools and special machinery, wants change; salary $22; at present employed; A-1 references. Box 381, AM. MACH.

NEW YORK

Experienced gasolene engine and automobile designer will be open for engagement after Jan. 1. Box 377, AMERICAN MACHINIST.

Mechanical engineer, competent, experienced man, with some capital, seeks business opportunity. Box 302, AMERICAN MACHINIST.

Position as foreman or assistant foreman in an up-to-date machine shop; 24 years' experience at general work; location, middle West. Address C. H., AMERICAN MACHINIST.

Wanted—Position by man, 27 years old, with general office, cost and factory accounting experience and has working knowledge of machine shop and foundry practice. Box 373, AMERICAN MACHINIST.

General foreman, age 36, responsible man, experienced in economical production, high-grade interchangeable general machinery, master mechanic; state salary. Box 376, AMERICAN MACHINIST.

Position as works manager with company employing about 200 men; am desirous of associating with a company that wants to cut the cost of manufacture and increase their output; excellent executive ability, successful in the handling of men. Box 374, AM. MACH.

Solesman—A practical mechanic, designer, toolmaker, machinist and estimator, traveled, college education, age 30, well versed in shop and factory equipment and the various tools appertaining to the metal industry, desires an opening in the capacity of salesman; will start with fair remuneration and prospects. Address Box 392, AMERICAN MACHINIST.

RHODE ISLAND

Toolmaker desires change; 14 years' experience on general tool work, jigs and fixtures, die work, gun, typewriter, gage and experimental work. Box 392, AMER. MACH.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

Wanted — Tool makers, die sinkers, drop forgers and men familiar with grinding machines. Apply to D. P. Beckwith, Pope Manufacturing Company, Hartford, Conn.

Wanted — Four first-class draftsmen for general work; must be rapid and accurate; in answering give full particulars as to age, experience in detail and salary required; positions will be permanent for right men. Address Box 389, AMERICAN MACHINIST.

ILLINOIS

A modern, progressive and growing factory, located in a fine city of moderate size, wishes to obtain the services of a designer of wide experience in accurate, complicated machinery, especially in difficult, automatic press work; the right man may expect a permanent position, with excellent future prospects; technical training, excellent record and reliable references are absolutely necessary; in replying, give an account of education and experience and state age, nationality, salary now received and salary required. Box 371, AMERICAN MACHINIST.

MASSACHUSETTS

Wanted—Metal patternmaker competent to take charge of metal pattern work; state age, experience and salary expected. Address Box 350, AMERICAN MACHINIST.

Wanted—Three or four first-class toolmakers on small work; steady employment, good pay; opportunities are good for right men. Box 382, AMERICAN MACHINIST.

Wanted—Good mechanical draftsmen with experience on high-speed steam engines. Address Engineer in Charge, Drawing Office, General Electric Co., West Lynn, Mass., giving full particulars regarding age, education, experience and salary expected.

MICHIGAN

Wanted—Sales manager for moderate sized, growing, prosperous machine-tool plant; good correspondent; state positions occupied, experience, age and salary wanted. Address, in handwriting, "Sales," AMERICAN MACHINIST.

MISSOURI

Wanted—Machinists, electricians, engineers and firemen, do you want to "get wise?" Send for 52-page pamphlet containing questions asked by different Examining Boards; sent free. Geo. A. Zeller Book Co., 53 South 4th street, St. Louis, Mo.

NEW JERSEY

Wanted — Ten good machinists and six good millwrights. Apply to New Jersey Engineering and Supply Co., Passaic, N. J.

Draftsmen—On general industrial plant extension, furnaces, mill buildings, pumping layouts, machinery repairs, etc.; state age, experience, initial salary and references. "General," AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work to good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

Superintendent — Corporation requires the services of competent man accustomed to the latest and best machine-shop methods and practice, capable of organizing and handling a machinery plant in all its branches; preference given man able to design special and automatic machinery, tools, jigs and fixtures for the rapid and economical production of fine and medium heavy interchangeable work. Box 366, AMERICAN MACHINIST.

NEW YORK

Wanted — Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

At our new factory — Toolmakers experienced in fine and complicated work; steady employment and good wages. Jones Speedometer Co., New Rochelle, N. Y.

Draftsmen on jigs and fixtures for duplicating work; none but experienced men wanted;

good pay for right men. Mergenthaler Linotype Co., 20-24 Ryerson St., Brooklyn, N. Y.

Wanted — Tool-room foreman, capable of handling 25 men on accurate work; please state age, experience in full, wages expected and references. Address Box 384, AM. MACH.

Technical men everywhere in spare time. No goods to sell; no expense; professors, draftsmen and literary machinists thus far appointed; state experience. Box 334, AM. M.

Wanted — Thoroughly experienced experimental mechanics on typewriter work by one of the front-stroke visible writing-machine companies; positions permanent; highest wages. Address "X X," AMER. MACHINIST.

Wanted—First-class lathe and horizontal boring mill hands on night shift, first-class floor hands day shift; no labor troubles; increasing force. Address, stating wages desired, Ingersoll-Rand Co., Painted Post, N. Y.

Wanted—A leading lathe hand for general work by a New York City manufactory; experienced breaking in and getting results from cheap help; state wages and experience; good opportunity for right man. Box 395, AM. M.

Wanted — Experienced emery-wheel salesman, with a practical as well as technical knowledge of the grinding-wheel subject; desirable position for the right party, with satisfactory references. Address "Wheel," care AMERICAN MACHINIST.

Wanted—One good man in every machine shop to sell Gre-Solvent to his fellow-workers; five to twenty dollars weekly may be earned, according to size of shop. Write us, stating shop where employed. Utility Co., Room 100, 332 Broadway, New York.

Wanted — An experienced mechanic with good address who understands thoroughly turrets, automatic machines, etc., to represent a well known house with an established trade, calling upon the iron and steel plants in western Pennsylvania and Ohio; state experience, age and salary expected at start. Box 375, AMERICAN MACHINIST.

A young man with a sound technical education, some practical experience in drafting room and shop, and competent to act as instructor in mechanical drawing and assistant to the superintendent in a trade school; salary $2000 to $2500 per year; write, giving age and full particulars as to experience, to Superintendent, 222 East 64th St., New York.

Wanted—Foreman for growing shop manufacturing instruments of precision by modern methods; must be a live man, well educated, up-to-date on modern manufacturing for duplicate parts, possess strong character and executive ability; unless you are positive you possess above qualifications, do not answer; state age, nationality, experience, wages expected, whether married or single, and give references. All correspondence strictly confidential. Address Precision, E. X., AM. MACH.

OHIO

Wanted — Experienced man to superintend the erection of electric cranes. The Case Mfg. Co., Columbus, Ohio.

Several first-class draftsmen thoroughly familiar with steam-hammer designing; state experience, age and salary expected. Box 301, AMERICAN MACHINIST.

Wanted — First-class designing draftsman familiar with automatic machinery and power punches; steady position to capable man. Box 388, AMERICAN MACHINIST.

Our growing business constantly requires additional machinists. We build lathes, planers, shapers, drilling machines; good opportunity for machinists. The American Tool Works Co., Cincinnati.

PENNSYLVANIA

Wanted—First-class jig and fixture makers for small fine work; state age, experience and salary expected. Box 361, AM. M.

Wanted—Foreman of machine shop employing 55 men; must be familiar with paper-mill machinery. Address Box 383, AMER. MACH.

Wanted—Ten machinists, general machine and bench hands; also two A-1 patternmakers. Apply to Scottdale Foundry and Machine Co., Scottdale, Pa.

Wanted—Tool, die and instrument makers; also a number of operators on large machine tools. Address Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—Fitters and vise hands for machine-tool work; steady employment and good wages to first-class workmen. Address Colburn Machine Tool Co., Franklin, Venango County, Pa.

Wanted—Machine-shop foreman wanted to take full charge of all vise work (small high-grade interchangeable parts) in large manufacturing plant; must be thoroughly able to get the maximum amount of work out at a minimum cost; very good opportunity for the right man; state qualifications, salary expected, and references. Box 362, AM. MACH.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: Character, common sense, experience with automatic machinery (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND

Toolmakers wanted — First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

WISCONSIN

Wanted — Working foreman for machine shop, building wood-working machinery; good opportunity for right party. Box 386, AM. M.

To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee, Wisconsin.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reason for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

WEST OF MISSISSIPPI

The J. Geo. Leyner Eng. Wks. Co., of Littleon, Colo., are increasing their plant and are in need of good mechanics, machinists, blacksmiths and sheet-iron workers. Littleton is a suburb of Denver, where cost of living is reasonable; superb climate the year round. Address above.

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COST- AND TIME-KEEPING OUTFIT OF THE TAYLOR SYSTEM

Some Conveniences and Short Cuts of Obvious Utility

EDITORIAL CORRESPONDENCE

One of the striking things about Mr. Taylor's methods of shop management is the way in which he reverses the methods usually employed. Thus, instead of a workman depositing a check or making any positive record on entering the works in the morning, he *removes* a slip from the time-card box, the fact that his slip is thus removed forming the record of his presence in the shop. This slip contains the workman's orders for his first job of the day and is shown in Fig. 1.* The time-card box is shown open and closed in Fig. 2. Each box contains spaces for 100 workmen's numbers, there being enough boxes at each entrance for the men who enter there. As the whistle blows, the boxes are closed, as shown by the right-hand box of the illustration and the workman who arrives late then goes to a window and signs the card shown in Fig. 3—crossing out the word "left." In case he leaves early he signs the same card, crossing out the words "arrived in." This card is then stamped by a clerk, in the upper left-hand corner, with a time stamp which records not the minute of arrival but the time by which the workman is late. That is, at 7 o'clock the stamp would make an impression reading 0.00 and at 8 o'clock 1.00. The parts of an hour by which he is late are not given in minutes but in tenths, as the decimal division of the hour is used in all the time-keeping operations of the factory. That is, if the workman is 15 minutes late the record reads 0.25.

IN
OUT

CHARGE SYMBOL

SHIPPING NUMBER	SHEET NUMBER	MARK	OPERATION NUMBER

DEPARTMENT DM
DAY RATE

IF JOB IS NOT FINISHED SCRATCH OUT THIS F
IF JOB IS FINISHED SCRATCH OUT THIS NF

DESCRIPTION	NO. OF PIECES FINISHED	MAN'S TIME	MACHINE TIME	MACHINE NO.

DRAWING NO. | INSTRUCTION CARD NO.

WORKMAN'S NAME MAN'S NO. DM

ROUTE SHEET	PAY SHEET	COST SHEET MAN'S	COST SHEET MACHINE	

GANG COST

DAY WORK TIME CARD

DM 1

FIG. 1. WORKMAN'S TIME TICKET

MAN'S NO. D

NAME

ARRIVED IN / LEFT THE SHOP TO-DAY AT THE TIME STATED ABOVE

ENTERED IN		
PAY SHEET		

SIGNED

DM 3

FIG. 3. LATE ARRIVAL SLIP

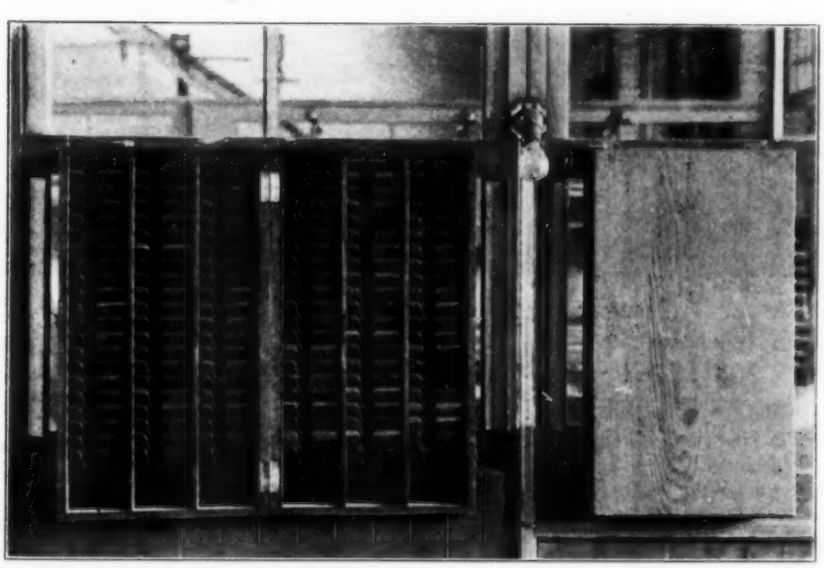


FIG. 2. TIME-CARD BOXES AT ENTRANCE TO SHOP

THE USE OF THE TICKETS

As the workman finishes his various jobs during the day the tickets are sent to the office, a new one like Fig. 1 being issued for each new job. The last ticket of the day is deposited by him in the time-card box, Fig. 2, as he goes out, the *F* or *N F* being crossed out as directed on the ticket to show whether the last job was finished or not. After the men have gone the finished tickets are removed to the

*The ticket shown is for work done on the day's-work plan, as indicated at the bottom. For piece work a different ticket is used, which it is not necessary to show in this connection.

planning department and replaced by new tickets for next day's first job. The not-finished tickets are treated in the same way, except that the new ticket is a copy of the one removed. The tickets collected at night and those that have been sent in during the day thus contain the complete record of the day's work and are first taken in hand in the morning by the time or pay-roll clerk. His desk is the farther one of Fig. 4, the racks for the tickets being arranged in swinging frames above his head as clearly shown. The rods by which the racks are suspended have varying lengths and centers, so that when elevated they clear one another but when swung down over the desk they all occupy the same position. The tickets are sorted in accordance with the men's numbers, which appear at the lower right-hand corners of the tickets, and are placed in the corresponding divisions of the trays—the completion of the sorting seeing every man's tickets for the previous day bunched together and from them the pay-roll is then made up.

This finished, the tickets are passed to the cost clerk at the rear desk, who has a precisely similar set of suspended trays over his head. The cost clerk next resorts the tickets in accordance with the job numbers, which appear at the upper right-hand corners, and places them in the proper divisions of the trays, thus bunching together the tickets belonging to each job, following which the cost records are made.

A DECIMAL CLOCK

Directly in front of the clerks, the edge of its rim just showing in Fig. 4, is a clock with its dial graduated as shown in Fig. 5, the usual division into minutes being replaced with tenths and hundredths of an hour. Like the time stamp already noted, the zero of this dial indicates starting time in the morning, the two hands standing vertically, or at 0.00, at 7 o'clock.

The clocks throughout the works have their dials divided in the same way and the entries on the time tickets are in accordance therewith, thus harmonizing at once with the time and cost clerk's clock.

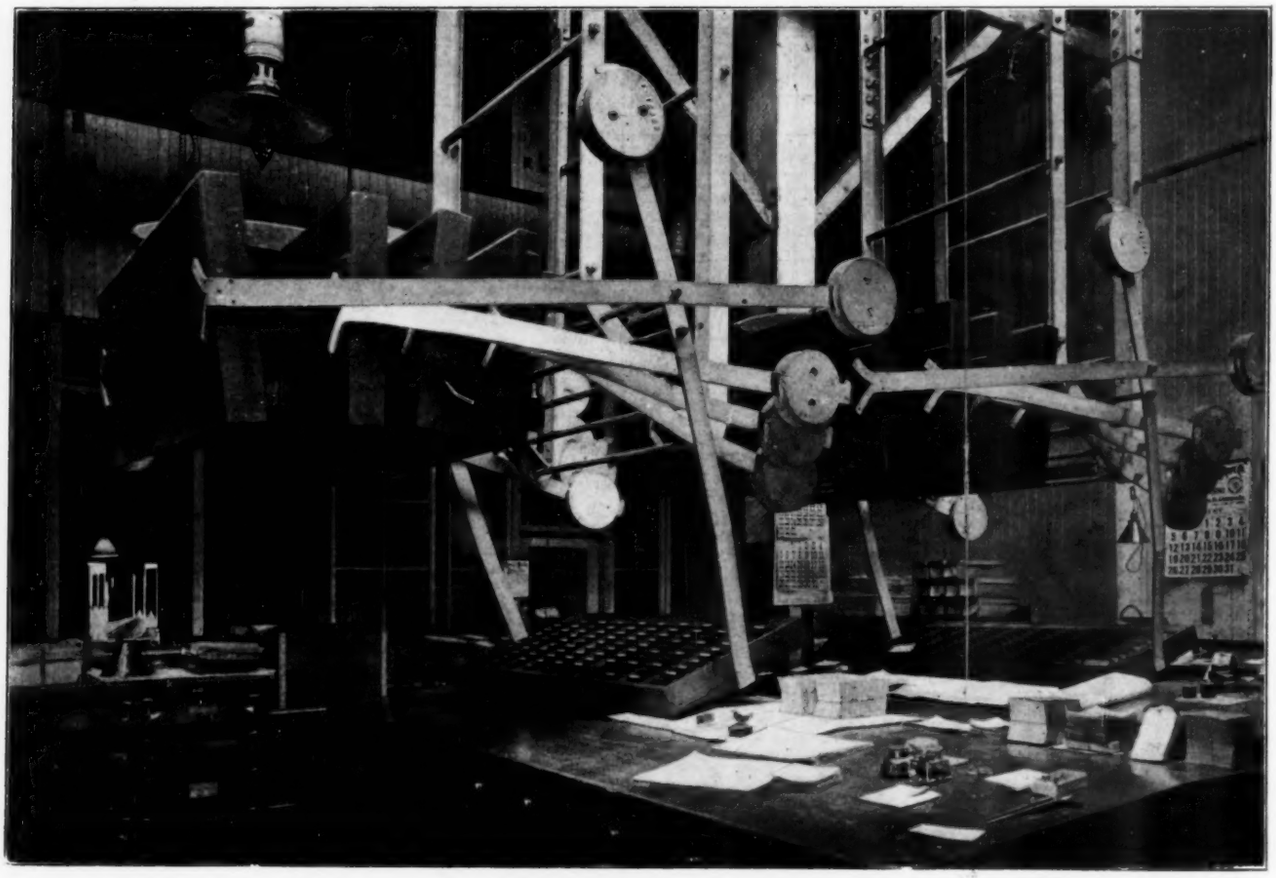


FIG. 4. TIME AND COST CLERKS' DESKS AND CARD RACKS

THE COST SHEET

The cost sheet, taken in connection with the decimal time system, is a remarkable time saver and is shown, much abbreviated, in Fig. 6. The actual sheet contains five sets of columns and is 15x23½ inches in size in order to provide room for pieces of work involving much time. It has here been abbreviated to three short columns for the sake of compactness. It will be understood that the sheet is a job sheet, the records on any one sheet being for a single job.

The left-hand set of columns is given to the men's time. The top line contains the hourly rates of pay for the men, the time of all men having the same rate being entered in the column under their common rate. The time entries are in hours and tenths, the decimal point being omitted. These entries when summed below give the total time under each rate of pay and a single multiplication for each column footing gives the dollars and cents summary for that rate, which is entered at the bottom but *turned around to read from the right-hand end of the sheet,* by which artifice further addition is obviously facilitated.

The middle set of columns is for bonus and premium earnings, which are entered in dollars and cents and added at the bottom as before. The ruling of this set of columns will be seen to be for dollars and cents.

MACHINE TIMES AND RATES

The right-hand set of columns contains the entries for the machine times. The top line contains the base charge for the use of each machine, this charge covering interest, depreciation, insurance, taxes and such other items of expense as do not vary from month to month. The hours for the machine are entered by the workman on the original ticket, Fig. 1, alongside of his own time, as indicated. Usually of course, though not always, the man's time and the machine time are the same.

As with the records for the men's time the machine time is entered in the column under the appropriate machine rate and without regard to the actual machine. The entries are finally summed at the bottom of the sheet and each total is multiplied by the rate at the top of its column giving the dollars and cents totals, which again are turned around to read from the right. These sub-totals are then summed and multiplied by a factor which covers such items of shop expense as vary from month to month, this factor being determined anew for each month. This operation is not included in the sheet shown but when done, the result added to the footings of the left-hand and middle sets of columns gives the final cost of the work as it leaves the shop.

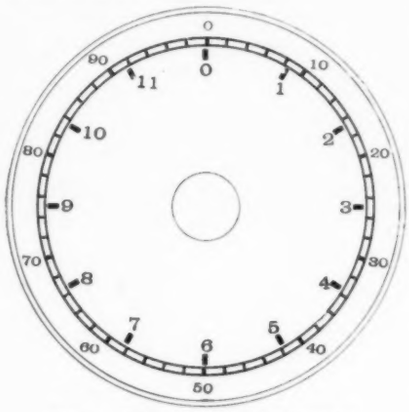


FIG. 5. DECIMAL TIME CLOCK DIAL

For the originals of the accompanying illustrations and for the information from which this article has been prepared I am indebted to the Link Belt Company, of Philadelphia, where the methods described are in use. F. A. H.

The forest service is experimenting to determine the best method of treating fence posts cut from dead lodgepole pine.

RESISTANCE OF TUBES TO COLLAPSE*

Important Experiments on Tubes of Boiler-Tube Size and Less

BY ALBERT P. CARMAN AND MAURICE L. CARR

This paper describes a series of experiments made on the resistance of metal tubes to collapse when subjected to external hydraulic pressure. The principal use of the results of such experiments is probably their application to the design and inspection of fire flues of steam boilers, but the results are also of great interest and importance in the theory of elasticity and the strength of materials. Engineer have used various empirical rules and formulas for the collapse of tubes, but these formulas have been derived from a few unsatisfactory experiments, and have within recent years been generally distrusted. This distrust has not been lessened by the mathematical discussions of the last few years, in which students of elasticity have attempted to derive a rational formula for tube collapses.

The present work was first planned by L. P. Breckenridge and A. P. Carman in the spring of 1904; but university duties prevented its prosecution at that time. In the winter of 1904 to 1905, a series of experiments on the collapse of small seamless-brass tubes was carried out by A. P. Carman. These experiments were described and the results discussed in a paper read before the American Physical Society at Chicago, April 23, 1905, and published later in the *Physical Review*. It was there shown that the formulas in general use, all of which are based on that of Sir William Fairbairn, are inadequate; that there is a certain "critical minimum length" beyond which the resistance to collapse of a tube is independent of the length; and that a formula of the rational type proposed by Prof. G. H. Bryan was probably nearly true for these small brass tubes.

The experiments discussed in this bulletin have been made by the department of physics of the engineering experiment station of the University of Illinois. They were begun in the fall of 1905, but owing to delays in getting apparatus and materials were not completed until May 1, 1906. M. L. Carr, B. S., has been the assistant in carrying on this series of experiments. He has made the observations, and to him are due several of the special devices used as well as much of the completeness and accuracy of the calculations. Before describing our own experiments and discussing the results, we shall give a brief account of previous experiments and of empirical and theoretical formulas which have been proposed.

HISTORICAL

The first, and until very recently, the only systematic experiments on the collapse of tubes were those of Sir William Fairbairn, made nearly 50 years ago.

Aside from Fairbairn's experiments, there have been no systematic experiments described until within the last year. It is noteworthy that a problem so widely discussed, the solution of which has not only great scientific interest, but also valuable technical applications, should remain for so many years with so little experimental work. The only reasons that can be assigned are the considerable expense

*From the University of Illinois *Bulletin*. Abstract.

involved in the experiments, and the fact that the appliances needed are not commonly available in testing laboratories.

The most remarkable feature of Fairbairn's formula is the dependence of the collapsing pressure upon the length. This will be discussed later. Immediately after the publication of Fairbairn's paper, one writer after another began to discuss the data for the purpose of deducing a more general and convenient empirical formula. Most writers had seen that there must be a limit to the length of tubes for which these formulas should be applied, but no results of experiments had been published previous to 1905 regarding this.

The previous experiments by the writer were made to test this principal characteristic of the Fairbairn formula, viz., that the collapsing pressure varies inversely as the length. Twenty-five small seamless brass tubes were collapsed by hydraulic pressure. The following conclusions were drawn: "An inspection of the data and curves shows immediately that there is a minimum length for each tube beyond which the collapsing pressure is constant; and further, that this minimum length is quite definite. Again, we see that for lengths less than this critical minimum length the collapsing pressure rises rapidly. As definitely as can be determined from these small tubes, the collapsing pressure varies inversely as the length, for lengths less than the critical length. In this they follow Fairbairn's formula and suggest that Fairbairn's tubes were all shorter than their critical lengths. An inspection of the woodcuts which Fairbairn gives for each of his experiments, and a comparison of these with the shapes of the brass tubes which have been collapsed in our experiments confirm this. Fig. 1 shows sections of the collapsed tubes. Fairbairn found exactly these shapes which we have obtained for lengths less than the critical length."

These previous experiments had thus shown the inadequacy of Fairbairn's formula, and they had particularly shown the very narrow range of the law of inverse lengths. When the present series of experiments on standard steel boiler flues was begun, little attention was therefore paid to the law of lengths, except to see that the tubes were longer than the critical minimum length.

METHODS AND DATA OF EXPERIMENTS

The method followed in the present tests was similar to that used by Fairbairn. The tube to be tested was closed at both ends, placed inside a stout steel cylinder, and there subjected to increasing external water pressure until the tube collapsed. The pressures were read by hydraulic gages. The cylinder used in all

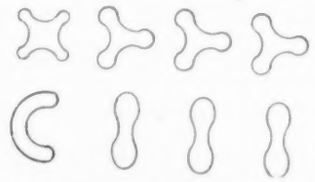


FIG. 1. SECTIONS OF COLLAPSED SMALL SEAMLESS BRASS TUBES

these experiments was a section of a nickel-steel naval-gun tube, Fig. 2, kindly furnished at a nominal price by the Bethlehem Steel Company, Bethlehem, Penn. The dimensions of this gun tube were: Length, 12 feet; external diameter, 7 inches; internal diameter, 5 inches. For a distance of 6 inches at one end the external diameter was left at 9 inches, thus making a shoulder against which the end plug could be clamped. This plug was a steel disk with a projection, and was held in place by heavy cast-iron rings and eight 1¼-inch steel bolts. A lead gasket with circular grooves in the end face of the tube prevented leakage even at the highest pressures. The other end of the nickel-steel cylinder was closed by a cast-iron plug, 6 inches long, shrunk into place.

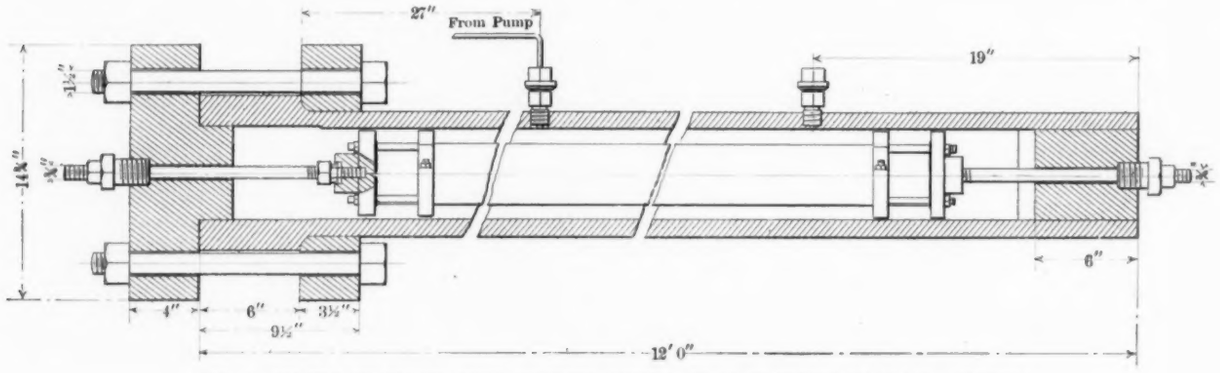


FIG. 2. SECTION OF NICKEL-STEEL CYLINDER WITH TUBE TO BE TESTED IN PLACE, SHOWING END PLUGS AND CONNECTION TO PUMP

METHOD OF MAKING THE TESTS

When a test was to be made, the prepared tube was placed in the cylinder, the heavy head bolted on, and the cylinder filled with water from the hydrant. All the openings were then closed and the pressure pump started. Several minutes of pumping were usually required before the gages began to record. Except for a few thin tubes of large diameter, failure, which was sudden in all cases, was accompanied by a sound much like that accompanying the failure of a specimen in a testing machine. Failure was also indicated by the dropping of the gages and the rise of the water in the manometer connected with the inside of the tube. Each specimen was carefully measured after collapse, and in the case of most of the tested tubes the collapsed portion was sawed across and the actual average thickness of the tube was obtained. Nearly all of the tubes tested were 10 feet long at the start. In many cases three or more collapses were made by cutting off the collapsed portion after each failure and then testing the remainder of the tube. The tubes tested were commercial-steel boiler tubes, both lap-welded and cold-drawn seamless. We have to thank J. T. Ryerson & Son, Chicago, for the gift of four tubes and the Scully Steel and Iron Company, Chicago, for the gift of 25 tubes for these tests. The other tubes used were bought in the open market. In order to have data on entirely different material, tests were made on a set of brass tubes similar in size to the steel tubes. The advantage of the brass-tube tests was that the dimensions and the material were much more uniform.

OTHER TESTS AND DATA

The present paper was practically completed when a paper appeared by Prof. R. T. Stewart, entitled "Collapsing Pressures of Bessemer Steel Lap-welded Tubes, Three to Ten Inches in Diameter." This paper was read by Professor Stewart before the American Society of Mechanical Engineers at the Chattanooga meeting, May 1 to 4, 1906, and at the present writing is available only in the advance papers of the meeting. It describes a very complete and valuable investigation made at the McKeesport works of the National Tube Company on the lap-welded steel tubes of that company, "the Tube Company generously providing every needful facility for carrying on the research in a most thorough manner." Tests on over 500 tubes are recorded, so that every advantage of averages is gained. Most of the experiments were on tubes of larger diameter than ours, Stewart's smaller tubes

being indeed the same as our larger tubes. Stewart's experiments are confined to lap-welded tubes, while the tests described in the present paper include also cold-drawn, seamless steel and brass tubes. The experiments thus supplement each other.

It will, of course, be impossible to make even an abstract of Professor Stewart's voluminous data, but the substantial agreement of our curves of results with his will be shown in the discussion. A considerable amount of experimental work was done by Professor Stewart in reaching his first conclusion, viz., that the law of inverse lengths did not hold for long tubes. As mentioned before, we had reached this conclusion in experiments described and published before the present experiments were begun.

CURVES AND FORMULAS

An inspection of the data of our experiments shows that the portion of a long tube by the collapse from hydraulic pressure is generally not longer than twelve times the diameter, and that for greater lengths the collapsing pressure is independent of the length. The law according to which the collapsing pressure varies inversely as the length is true only for very short tubes, i.e., tubes shorter than a certain "critical minimum length," which in most cases is from four to six times the diameter. We can thus omit further consideration of all formulas of the Fairbairn type in which the length appears in the denominator.

All considerations show that the collapsing pressure of a tube is a function of t, the thickness of the tube wall, and also of d, the diameter, varying directly as some function of t, and inversely as some function of d. Further, all the theoretical discussions indicate that this collapsing pressure is a function of the ratio $\frac{t}{d}$, i.e., that t and d have the same exponents. The simplest method of showing and studying the relation between p, the collapsing pressure, and the ratio $\frac{t}{d}$ is the graphic one, constructing curves from the experimental data. In Figs. 3, 4, and 5 such curves are drawn. In all these curves, the ordinates represent the values of P, and the abscissas represent the corresponding values of

$$\frac{t}{d},\ \frac{t^2}{d^2}\ \text{and}\ \frac{t^3}{d^3}.$$

Fig. 3 is for drawn brass tubes, Fig. 4 for cold drawn seamless-steel tubes, and Fig. 5 was made by taking the numerical results from Professor Stewart's paper on lap-welded steel tubes and calculating the ratios. While our tables contain results of a large number of tests of lap-welded tubes, these tubes were all thick and also of about the same thickness, so that they gave but few points of a curve. We relied on the cold-drawn steel and the brass tubes for the form of the complete curve, as these tubes were more uniform in thickness, diameter, and probably in material also than the lap-welded tubes. The agreement in the general shape of these curves for tubes of different materials and from independent observations is good evidence of the general reliability of the experimental data. An examination of these curves shows the following:

(1) For thin tubes, i.e., for values of $\frac{t}{d}$ below about 0.025, the formula $P = k\left(\frac{t}{d}\right)^3$ is very nearly true. This assumes that for this portion of the curve of P and $\left(\frac{t}{d}\right)^3$ the curve is practically a straight line. The constants have been calculated and the formulas are as follows:

(a) For thin brass tubes:

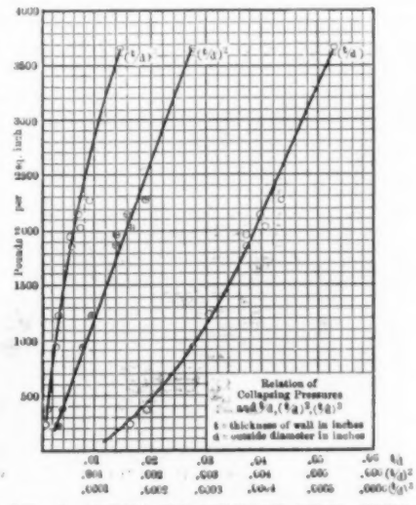


FIG. 5. CURVES FOR BESSEMER STEEL TUBES, DATA FROM PROF. R. T. STEWART

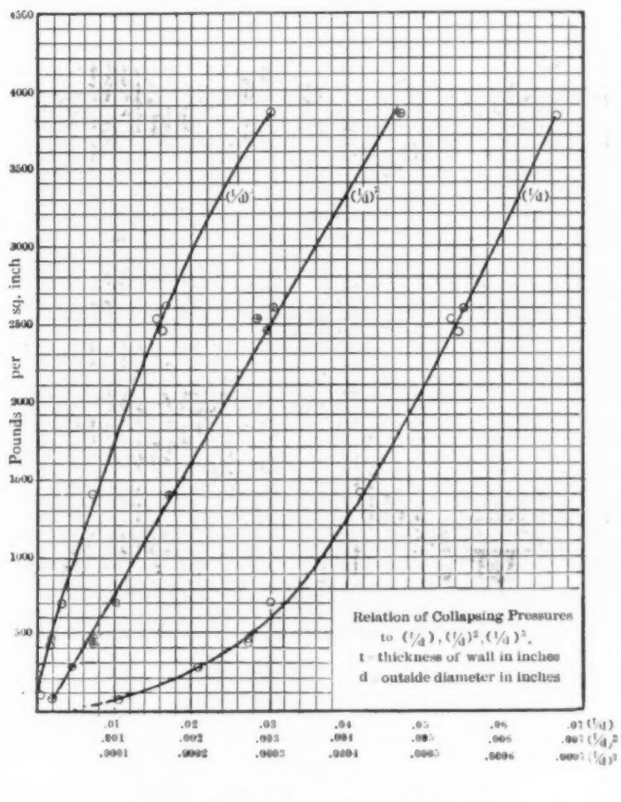

Pounds per sq. inch
Relation of Collapsing Pressures
to (t/d), (t/d)², (t/d)³.
t = thickness of wall in inches
d = outside diameter in inches

FIG. 3. CURVES FOR DRAWN BRASS TUBES

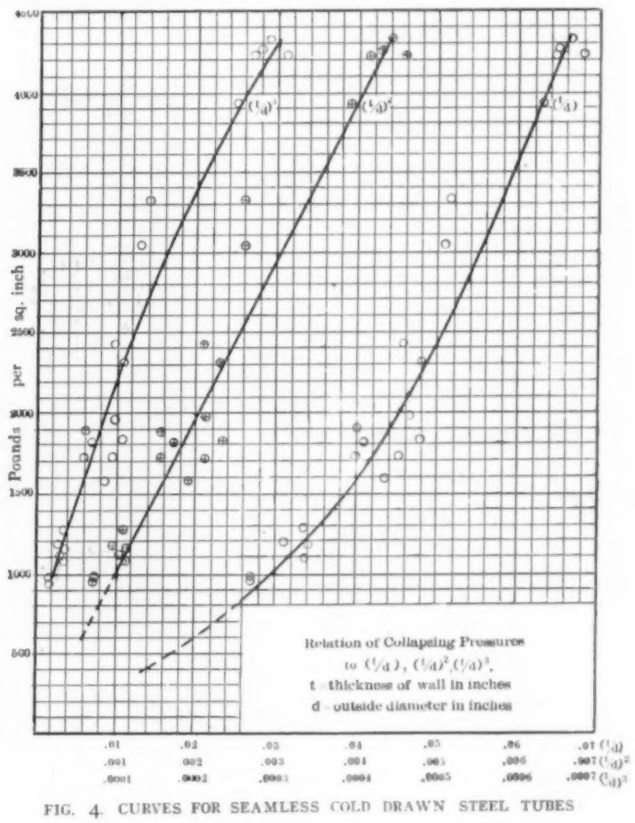

Pounds per sq. inch
Relation of Collapsing Pressures
to (t/d), (t/d)², (t/d)³.
t = thickness of wall in inches
d = outside diameter in inches

FIG. 4. CURVES FOR SEAMLESS COLD DRAWN STEEL TUBES

$$P = 25{,}150{,}000 \left(\frac{t}{d}\right)^3.$$

(b) For thin cold-drawn seamless-steel tubes:

$$P = 50{,}200{,}000 \left(\frac{t}{d}\right)^3.$$

All of the lap-welded tubes tested by us were thick tubes. This formula with practically the same numerical coefficient applies to the thin tubes given in Stewart's tables of results.

(2) The curve of P and $\frac{t}{d}$ is nearly straight for the thick tubes, i.e., for tubes having a value of $\frac{t}{d}$ greater than about 0.03. For thinner tubes the curve bends rapidly toward the axis. The straight part of the curve can evidently be represented by an equation $P = k\left(\frac{t}{d}\right) - c$, where k and c are constants. We have calculated these constants from our data and find the following formulas for tubes having a ratio $\frac{t}{d}$ greater than 0.03:

(a) For brass:

$$P = 93{,}365 \frac{t}{d} - 2474;$$

(b) For seamless cold-drawn steel:

$$P = 95{,}520 \frac{t}{d} - 2090;$$

(c) For lap-welded steel:

$$P = 83{,}270 \frac{t}{d} - 1025.$$

Professor Stewart found for his lap-welded tubes the formula

$$P = 86{,}670 \frac{t}{d} - 1386.$$

This formula, as thus stated, is purely empirical and its lower limit is entirely arbitrary.

(3) An approximate formula of the form $P = k\left(\frac{t}{d}\right)^2$, is suggested by the curves of P and $\left(\frac{t}{d}\right)^2$, particularly for the steel tubes. For cold-drawn seamless-steel tubes this approximate formula is

$$P = 1{,}000{,}000 \left(\frac{t}{d}\right)^2,$$

and this can be used for tubes for which $\frac{t}{d}$ is less than 0.06. For lap-welded steel tubes the same formula becomes

$$P = 1{,}250{,}000 \left(\frac{t}{d}\right)^2,$$

and this can also be used for values of $\frac{t}{d}$ less than 0.06. This approximate formula has been useful to us in getting probable collapsing pressures and gives satisfactory rough values for tubes of the most common commercial thickness.

In applying any formula to calculate the collapsing pressure of a particular tube, a considerable factor of safety should be used. The constants in all these formulas are large, and $\frac{t}{d}$ (or a power of $\frac{t}{d}$) is a comparatively small quantity, so that a small change in the numerical value of $\frac{t}{d}$ greatly affects the result. Lack of uniformity in the material and slight deformations are also very important factors. It is to the credit of modern manufacturers of tubes that their product is as uniform as these tests show. With the knowledge which this discussion gives of the law of tube collapse, the user of tubes is in a position to calculate with fair approximation the collapsing pressure, particularly if he can get tests made of one or more sample tubes of the material so as to fix the constants.

While the advance in this field of investigation is thus considerable, yet much work remains to be done, especially in connecting the subject more closely with the ordinary equations of elasticity.

It is announced that the Baldwin Locomotive Works will expend about $100,000 on its own building and exhibit at the Jamestown Exposition. The building will be 125x225 feet, of colonial architecture.

A Crank-pin Hole-boring Outfit

EDITORIAL CORRESPONDENCE

Getting the crank pins truly parallel with the shaft is one of the chronic difficulties of an engine-building shop. Truth in the holes as bored does not insure truth in the pin, as the disturbing influence of forcing the shaft and pin home and especially of keying the shaft in place come in to affect the result.

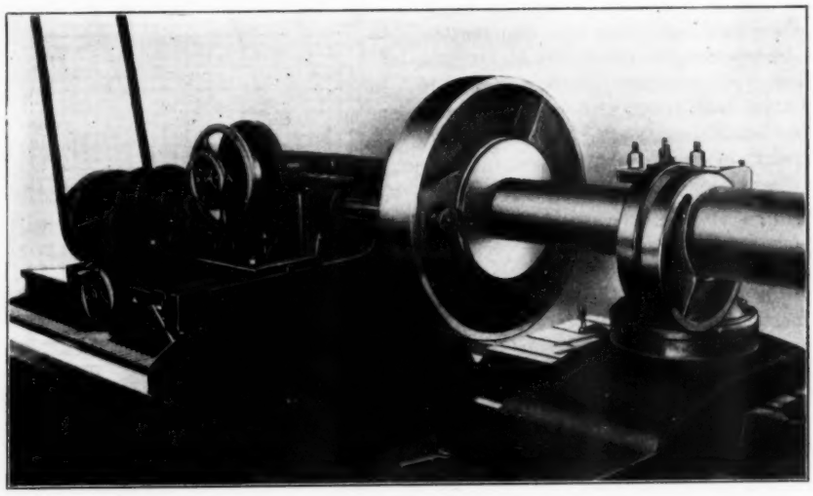


FIG. 1. CRANK-PIN HOLE-BORING OUTFIT

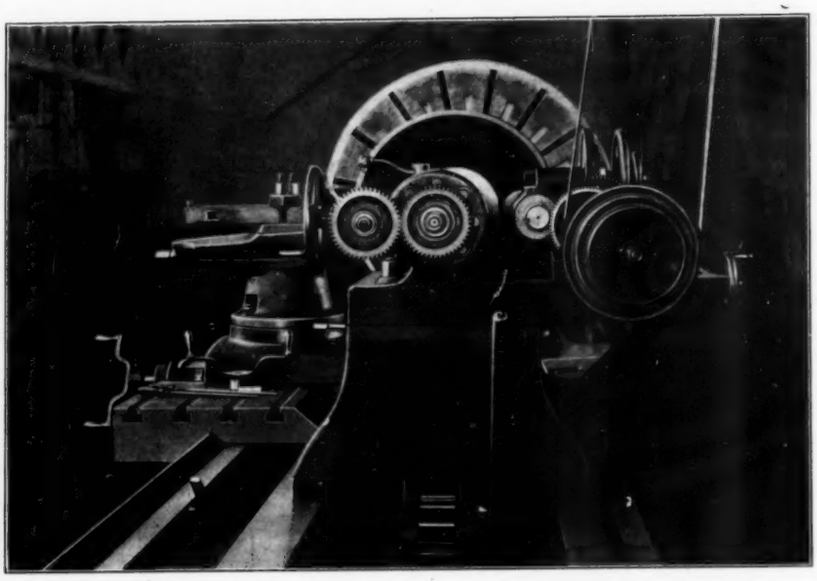


FIG. 2. CRANK-PIN HOLE-BORING OUTFIT

The accompanying illustrations show an outfit for doing this work which is in use at the works of the Canadian Rand Drill Company at Sherbrooke, Que., the idea being due to Andrew Sangster, superintendent of the works. By it the pin hole is bored after the shaft is forced and keyed home, the only disturbing influence remaining being the forcing home of the pin, the length of the fit compared with its diameter and the absence of a

key reducing this to a point where it is negligible.

Fig. 1 shows the tailstock of a Bertram lathe with a shaft and crank in place and a pin hole in process of being bored. The boring rig will be seen to be a part of the tailstock, as which it was originally built and, the boring bar being parallel with the center line of the lathe, truth in the hole is obviously insured. The bar is driven from a special overhead drum permitting the attachment to be used throughout the range of shaft lengths used. The adjustment for length of crank throw is obvious, the length being given by a graduated scale on the side of the bracket. Both power and hand feeds are provided, the former being taken from an intermediate driving-gear shaft, as clearly shown. Fig. 2 shows a rear view of the device. F. A. H.

A Radial Driller

The half-tone, Fig. 1, shows a new design of radial drill, one object of which is to provide a ready means of changing from cone-driven to geared speed-box drive.

The back of the column has a flange which is faced to receive the geared speed-box (when it is desired to drive in this manner) or a flanged bearing for the lower driving shaft, which supports the cone pulley when the machine is arranged for cone drive. In the latter construction an overhead countershaft is furnished with tight and loose pulleys.

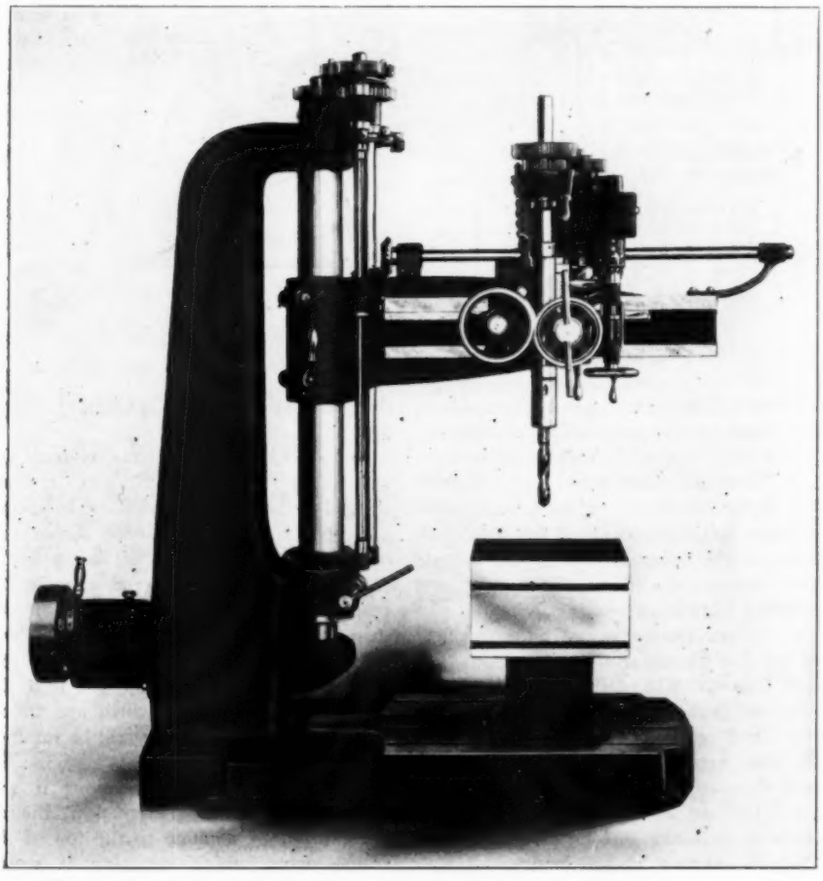


FIG. 1. A RADIAL DRILLER

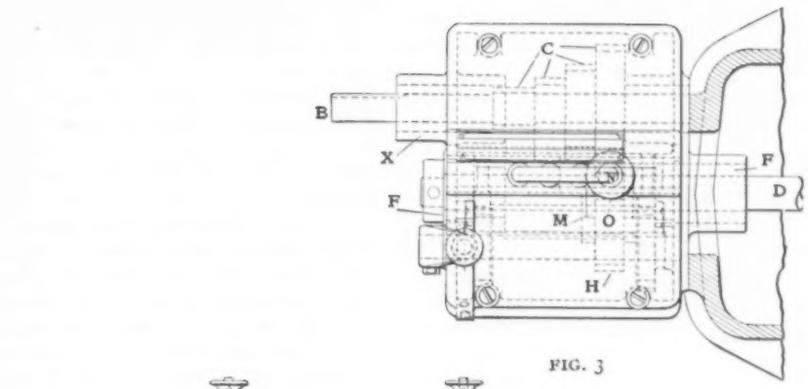


FIG. 3

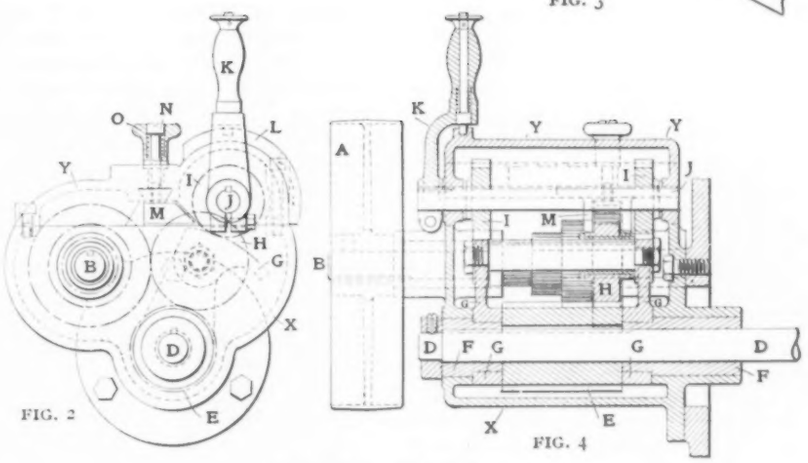


FIG. 2 FIG. 4

DETAILS OF THE SPEED BOX

The power is transmitted by a horizontal shaft from the speed-box through the lower part of the housing and through bevel gears to a vertical shaft which takes its bearing within the column. A spur-gear connection at the top of the column drives an outside vertical shaft which transmits its power through miter gears to the horizontal shaft on the arm.

THE SPEED-BOX

The speed-box arrangement is more clearly shown in the line cuts, Fig. 2 being an end elevation, Fig. 3 a plan and Fig. 4 a front elevation in section. The driving pulley *A* is mounted on the shaft *B*, which carries a cone of gears *C*. This shaft runs in phosphor-bronze bearings and is supported at both ends of the speed-box housing *X*. The shaft *D*, which has bevel-gear connection with the vertical shaft within the column, has a spur gear *E* keyed to it; the face of this gear is made as wide as the length of the cone of gears *C*. This lower column shaft *D* runs in phosphor-bronze bushings *F* which form supports for the rocker arms *G*. The rocker arms *G* carry a stationary shaft and support a sliding intermediate gear *H*, which is at all times in mesh with the wide-faced gear *E*. The rocker arms have toothed sectors at their peripheries and engage with pinions *I* keyed and pinned to the shaft *J*. This shaft is sup-

ported in bearings in the upper half *Y* of the housing *X* and has an arm *K* keyed and clamped to it, which arm carries a handle and detent pin to engage the various holes drilled in the segmental portion *L* of the top cap of the housing *Y*. The positions of the detent pin holes are of course determined by the diameters of the gears on the driving shaft *B*. The endwise movement of the sliding gear *H* is controlled by the shoe *M*, which slides in a dovetailed bearing in the top cap *Y*, spans the outer face of the gear *H* and has a stud *N* which passes through a slot cored in *Y*. The stud *N* supports the knob *O*, which is spring-seated and arranged to engage into counter bores shown in Fig. 3.

The speed is designated by the index plate secured to the top of the speed-box, which shows the list of speeds with and without the back gear. In making a change of speed it is necessary to throw the lever *K* forward, slide the knob *O* to the desired position and bring the lever *K* back until the detent pin engages the proper hole. This speed-box is provided with forged-steel gears throughout and all changes of speed can be effected while the machine is in motion, without injury to the working parts. This device gives eight changes of speed with the back gear, which is believed to be a range sufficient for machines of this size. All exposed gears are covered. This machine is also provided with a swinging table and a worm-swiveling table when so ordered, and is made in three sizes with 2½-, 3- and 3½-ft. arms. The maker is the John B. Morris Foundry Company, Cincinnati, Ohio.

Small, Vertical, High-Speed Engines *

BY F. R. STILL

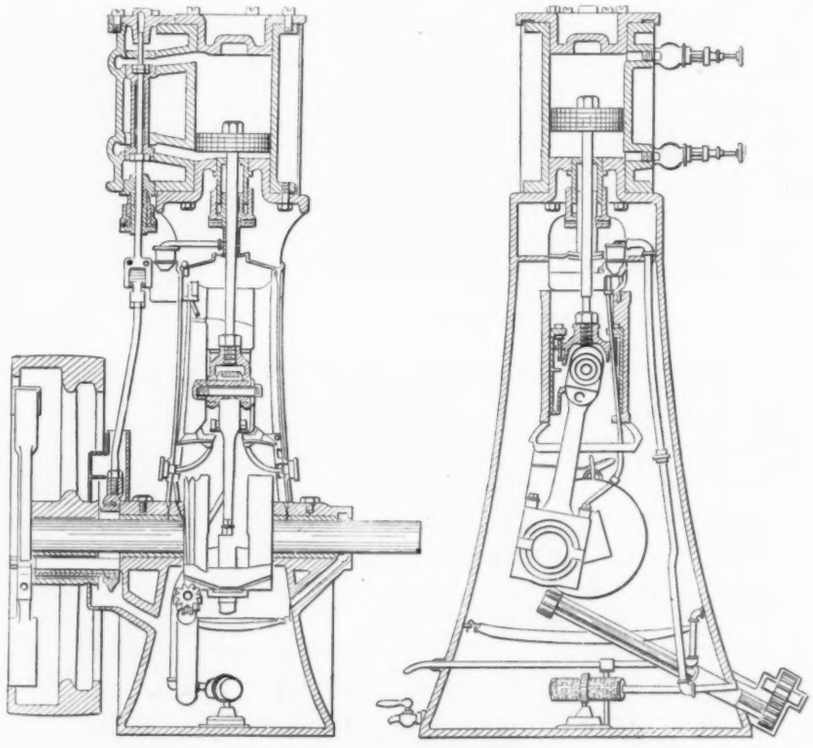
Having had years of experience with various other makes of small engines, and comparing experiences of the past with those of the last three years, it has been found very difficult to avoid an almost exclusive reference to the one recently developed by an engineer associate of mine in the employ of the same company I am connected with.†

From experience and close observation it was decided that fully 80 per cent. of the small engine troubles are due to improper lubrication; whereas only about 10 per cent. are due to inadequate proportions and finish of the working parts, and the other 10 per cent. to the neglect or ignorance of the operator.

It will thus be seen that if such conclusions are correct, the efforts of most of the designers have been in the wrong direction; that greater attention should be paid to proper lubrication and refining some of the details than to the production of something entirely new, with which there are likely to be as unsatisfactory results as before. Anything radically new is more likely to be misadjusted by the average engineer than something built on lines with which he is perfectly familiar.

Being so satisfied that these conclusions and deductions were correct, it was decided to carry them into effect, if with no other result than to prove their fallacy.

To get away from any fixed notions, and to gain new ideas from the practice of others and, further, to give " an opportunity to criticize somebody else," an engine designer of long experience in some of the best shops in the country was engaged.



GRAVITY-OILED SMALL ENGINE

Before him were spread these ideas, also what he was expected to accomplish. This briefly was as follows:

1. An engine that could be sold with a guaranty that it would run three months or more without requiring any attention, either to the oiling system, or for adjustments, except the filling of the sight-feed cylinder lubricator.

2. An engine that would be economical in the use of steam and oil.

3. That could be easily adjusted and not liable to easily get out of adjustment.

4. That could be used anywhere and for any purpose that an engine can be used for.

5. That had ample bearing and wearing surfaces to make it long lived and unlikely to overheat at full load.

6. That it should be constructed of the best materials for the purpose intended.

7. That it should be devoid of any semblance to "freaks" of every sort; and last, but not least, and, perhaps, the most difficult of all, it must not be so costly to build as to make the selling price prohibitive to the average buyer.

How well these requirements have been accomplished is shown by the satisfactory reports since obtained from the engineers having charge of them.

Being so thoroughly impressed with the importance of a good system of lubrication, the first step was to work out something more effective than previously used.

It does not take much thought to arrive at the conclusion, that if metal does not run on metal, but is always separated by a heavy film of oil, there can be very little wear. The problem then settles down to the production of the necessary heavy film.

In looking over the many systems for lubricating engines, the most rational seemed to be forced lubrication by means of a pump. But experience shows this has many defects. The oil being under pressure necessitates extreme care in adjustment, as any bearing being looser than another vents the entire system and destroys the desired effect. Again, any foreign material that may get into the small tubes or grooves which are an essential part of this system will be rammed in tight by the oil pressure.

To overcome these objections it was decided to adopt a gravity flow, the oil being lifted by a pump to the top of the frame, from which elevation it would flow downward by gravity. In this way

*Extracts from a paper read before the Detroit Engineering Society.

†American Blower Company, Detroit, Mich.

large tubes can be used; the velocity of the oil will be rapid, the volume of oil in circulation will be much greater, it will not be necessary to have the bearings tight, neither will they all have to be adjusted exactly alike, and any foreign matter will be washed out instead of being rammed in.

Being satisfied that this came close to the ideal way of producing the flow of oil, the next step was to distribute the oil along the bearing and wearing surfaces to completely separate them by that all-essential film.

For ages it has been common to groove the upper or lower half of the journal box or perhaps both. There are as many ideas on the proper way to groove a box as there are people in the business, and there are evidently many more who have no ideas at all, judging from the way it is sometimes done.

Considering the question from a mechanical standpoint, it is at once apparent that an oil film takes up space, so a bearing cannot be tight or the oil cannot get in unless it is forced in at a pressure greater than is exerted on the journal.

The thicker the film, the more space there must be between the metals, hence a loose bearing is desirable if it does not cause pounding.

When the crank is on the downward stroke, it pushes the journal away from the upper part of the bearing. The shaft is also rolling in the direction the crank is traveling. Hence, the oil should enter at the beginning of the gap which intervenes between the shaft and bearing and thence be rolled up into the remaining space by the rotation of the shaft. The gap naturally begins at one side of the circumference of the shaft, so the oil grooves should most naturally be on the sides.

After the crank passes the lower center on the up-stroke, oil should flow in from the groove on the opposite side in the same way. These grooves can thus be made large, say from ¼ in. to ⅜ in. in width and the whole length of the bearing metal.

The same scheme is applicable to the oiling of the main bearings, crank pin, crosshead pin, eccentric and governor weight pin, and it works to perfection, better even than was ever thought possible.

To gain some idea of the way it is working, it may be in order to point out a few cases.

Cards were sent to nearly all the purchasers of these engines, asking them to have their engineer answer the questions printed thereon. The questions were as follows:

Size of engine?

When installed?

Revolutions per minute?

Steam pressure?

How often has oil been added since starting?

Quantity of oil added each time?

How often have adjustments been made?

Where have adjustments been made?

Replies were received in nearly every instance, and with the exception of five or six, they all ran over five months without any adjustments or additional oil

One most exceptional case was at Davenport, Ia., where a 14x7-inch low-pressure engine is running in a school building. The speed is 180 revolutions per minute, the steam pressure 40 pounds. At the start 4.5 gallons of oil was poured into the base and in two years only one gallon has been added and one adjustment made, which was to the crosshead pin.

In New Orleans an induced-draft fan was installed on an ocean tug, which is driven by a 5x5 direct-connected engine. The steam pressure is 110 pounds. The engine runs about 360 revolutions per minute. The outfit was installed in February, 1904, and up to November 29, 1905, about twenty-two months, only three gallons of oil had been put into the engine and one adjustment made to the crank pin. This engine runs continuously, 24 hours per day for three or four days at a time. It is seldom that it ever stops entirely, as it is turning over slowly even when the tug is tied to a dock. It is located in a very hot place over the boiler and withal is operated under about the worst possible conditions.

At the plant of the Trexler Lumber Company, Allentown, Penn., is another engine driving a blower which is attached to a dry kiln. This was installed February 5, 1905, and up to November 18, 1905, only one gallon of oil had been added and one adjustment made to both the crank and crosshead pins.

This engine runs steadily at 285 revolutions per minute, 24 hours per day, without stop for Sundays or any other day.

These few citations are sufficient to show the remarkable effectiveness of the oiling system.

There were many other problems in the perfection of this system which had to be worked out, that were, perhaps, equally as interesting in connection with the oiling system. For instance:

After the oil has performed its usual functions it must be filtered, cooled and the water separated from it. Any of the usual methods of filtration were found unreliable, as they all allow pieces of lint or grit to pass through. After much experimenting it was found that a plain closely woven cloth suspended by four hooks from each corner of the frame, hanging just below the crank and above the oil in the base, gave the best results. All the oil dripping down from above lodges on this cloth and passes through to the reservoir below. Any foreign matter is left on top and has no tendency to leave the upper surface. Simple as it is, it has been surprisingly effective. As an extra safeguard a fine copper wire screen of ample area was attached to the pump suction and another to the discharge, both being easily removable for cleaning.

Another source of possible trouble which had to be guarded against is the loosening of core sand from the frame.

No matter how much care may be exercised in cleaning a casting, some sand is sure to stick for awhile, loosen later and cause serious trouble.

To prevent this the frame is painted inside with two coats of thick white enamel. It took a lot of experimenting to get an enamel that would stand the heat, moisture and oil without softening, but it was finally procured.

The pump first adopted was of the plunger type, actuated by an eccentric on the shaft. It was thought too complicated, however, and was abandoned for a gear pump. On the shaft is a large bronze worm with coarse teeth into which meshes a small spur gear attached to a shaft supported at an angle of about 45 degrees. The pump gears are within a case attached to the outside of the frame close to the bottom of the base, where they can be gotten at any time.

The discharge pipe from the pumps is 0.75 in. diameter, and extends up inside of the frame to the top, where it discharges through a sight-feed glass, so the engineers can easily see if the oil is flowing properly.

The oil then empties through a wire screen into a small tray, through the bottom of which latter project the various oil tubes nearly to the top of same. Each tube has a fine slit cut down the side of it to the bottom of the tray, so as to equalize the flow of oil into them all.

In adjusting the engine for this system no bearing should be so tight as to make it impossible to easily slide the connecting rod or shaft along parallel with its axis.

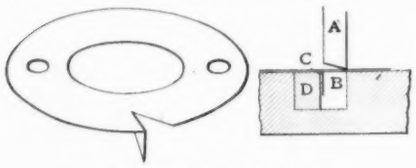
An eminent New York engineer and practical builder who has to his credit many of the finest skyscrapers, states that a one-hundred story building, built of reinforced concrete, and towering more than 1000 feet from the ground, may yet be seen by people who are living. The 50-story buildings which are being seriously considered will constitute but a stepping stone to the 75-story buildings and then to the 100-story buildings. The principal drawback which now presents itself is said to be the impossibility of providing elevator accommodations for even a 50-story building, for the reason that the weight of cable to support a car in the present 30-story buildings is enormous, and some other method of utilizing the upper floors will have to be invented and introduced before the skyscraper can be built any higher. The limits of the elevator, as understood at this time, have already been reached.—*The Manufacturer.*

CORRESPONDENCE

Discussing Phases of Machine Design and Construction

Sheet-metal Stamping on the Drill Press

When I read J. E. P.'s article at page 545, on "Stamping Work in a Shaper," there came to my mind a case when I converted a drill press into a very good punching press. It was some 18 or 20 years ago, which will, I think, excuse me



THE JOB AND THE TOOLS

from going into details in the description. I was at the time conducting a small repair business in one of our New England towns. A cotton mill was near by, for which I did a good deal of repair work. One day the superintendent of the mill came in with a small circular stamping of thin, soft sheet steel. He had cut into one side of its periphery with a shear or chisel, and had turned down a point, as shown at Fig. 1. They had several thousand of these, which they wished treated in this manner. They were, perhaps, 1½ or 2 inches diameter, and very thin, probably not more that 1/50 inch. The superintendent thought we could make a punch and die, and use a hand hammer for the blow. I quite agreed with him, but before we got at the job I had a different idea, which was executed.

We had a 25-inch drill press, the quick return of which operated with a lever, and worked very easily. We made the punch, which was at once a shear and forming tool, with the body fitted to the taper hole in the spindle. A block of cast iron was used for a die block with a piece of tempered steel fitted, as at *D*, Fig. 2. The block was recessed sufficiently to admit the thin disk to hold it in position. With the punch brought down into the die, the die block clamped to table, which was also clamped rigid, with the hand lever in a convenient position, the belt off and the driving gear clamped so it could not turn, all was ready for the job. In Fig. 2 *A* represents the punch or shear, *B* the shearing edge of the die, and *C* the rounded corner, over which the little point of metal was bent. I can only say that it worked fine. Its speed was limited only to the rapidity with which the operator could handle the work, and to the endurance of the right arm which worked the lever. The pieces were first shaken up in a box with a little oil, for the purpose of lubrication, and the lot run off in a remarkably short time. E. DE HART.

Boring Bars and Cutters

The accompanying sketches show a boring bar with double adjustable cutters near the end of the bar to be used by being clamped to the cross slide of the lathe in one of the many devices for this purpose which have been shown in the AMERICAN MACHINIST.

The same arrangement of cutters can be placed near the center of the bar supported on the lathe centers for boring work secured to the lathe carriage.

The two cutters being placed opposite each other, each helps to hold the other to its cut, doing much faster work than a single cutter.

The cutters have a slight top rake as shown by the center line *A*, which may be increased or diminished by grinding.

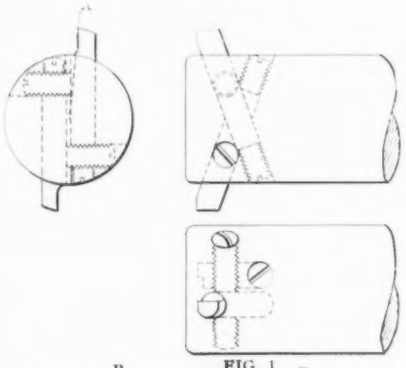


FIG. 1

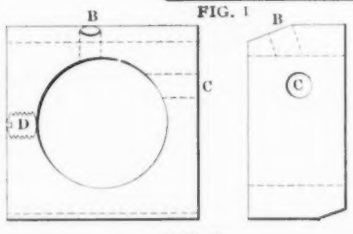


FIG. 2

DOUBLE ADJUSTABLE BORING-BAR CUTTERS AND JIG FOR MAKING THEM

The cutters being placed at this angle allows top rake to be given without excessive grinding and growing out on the top which weakens the cutter, and does no harm if the top rake is not required, as the extreme edge only need be ground off.

The jig Fig. 2, is used for drilling the holes for the cutters and the set screws, at the required angles. The jig is secured to the bar by the set screw *D*. The hole *B* is drilled for one cutter and the hole *C* for the set screw which binds the cutter. The set screw *D* in the jig is then released and the jig turned half way around and again secured by the set screw *D*, and the bar is drilled as on the opposite side.

The holes *B* for the cutters are drilled the size of the cutters to within one half inch of the opposite side of the bar, then a tap drill is run all the way through and the tap run in from the same end insuring a thread true with the hole.

The holes *C* for the set screws are drilled clearance size until the drill cuts a full circle, then a tap drill is run in the rest of the way and the hole tapped with the jig in place, as for this short hole the jig is necessary to hold the tap in alinement. M. H. BALL.

Checking Drawings

I am an enthusiastic reader of the AMERICAN MACHINIST, and, whenever the heading "Checking Drawings" appears, I settle back in an old arm chair with the expectation of getting something to help me on my strenuous journey.

In my present position, I am responsible for the work of about a dozen draftsmen, and from the looks of some drawings when returned for corrections, the shop would be in a deplorable state most of the time, if these changes were not made. Perhaps our men are not up to the standard, but they come about as near it as the draftsmen in the several shops where I have gathered my experience; and from what I can learn by talking with people in authority at a good many other places, they are about on a par with the average. I hope I am not one of the checkers with a "swelled head," for my experience has taught me that about the time a fellow gets a case of expansion of the "think tank," something is sure to happen to knock holes in the tank, and that something is, generally, enough to bring him on a level with the fellow making the errors that make a checker necessary. Yes, I say necessary, for although I can imagine a drawing room being run without a checker, I cannot imagine how it would be possible to get one-twentieth enough draftsmen to supply all the drawing rooms in the United States, if they were all run without checkers, unless half the concerns went broke checking work by erecting it in the shop.

KEEPING THE DRAFTSMAN IN GOOD HUMOR

I have climbed the ladder so far from the bottom, and have felt many times like twisting the checker's ear for the marks he put on my drawings, and now I know how hard it is to check drawings, and do it right, keep the draftsman in a good working humor, and at the same time impress on him the seriousness of his mistakes. *There* is the proposition, and I find it takes a lot of tact, system and patience. The best way I have found to keep the draftsman from depending on the checkers is to bring the seriousness of these mistakes right down to the money question. This can be done in several satisfactory ways, but the card system is the best I have found. When a man starts a job, make out a card for it, and keep a record on that card of all errors he makes, including the ones that are caught while the layouts are being made, and all changes made by the checkers, although these are not always mistakes. Return the checked drawings to the draftsman, with the card to be used as a guide for making the necessary changes. When the drawings are completed, file the card under the draftsman's name. By reference to these cards, it is an easy matter to judge the quality of the work of each man, and pay him accordingly.

I think the way our friend, Mr. Alton, at page 641, speaks of impressing the draftsman (by the violent vocabulary of the boss) that he has made a mistake, is one used in a good many places, and is about the worst way it can be done. It gets on the men's nerve, makes them angry, puts them in a "don't care" humor, and nine chances out of ten, before they recover from it, they will make a bull about twice as bad as the first. All men are human, and to get the best results, it is necessary to treat them as such. Some foremen swear and curse at their men, and such foremen should be treated to an extended leave of absence. I cannot imagine men *wilfully* making mistakes, unless they are sore on the checker, and try to get something through on him, and a drawing room is better off without that kind of men.

The checker is not infallible, and some mistakes are bound to get through; but in the last eight months, $20, at a good estimate, would cover all mistakes caused by the slips in our drawing room, including small interferences, where not enough clearance was allowed for uneven castings and other small things that are bound to happen.

UNIFORMITY IN DRAWINGS

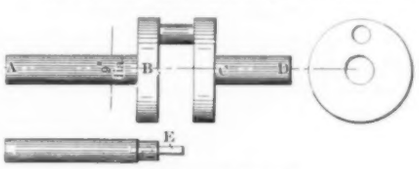
A checker should have the authority to dictate how drawings should be made, or if not the checker, then someone who is thoroughly competent to judge the best and clearest way of showing things to the mechanic. This applies more especially when a number of different sizes of the same design are to be made, when the first set should be gone over very thoroughly, and every effort made to get them in the best possible shape. They should be used as a guide for the other sizes, the views, dimensions and general arrangement corresponding to the model set. When checking, I am in no way partial. All drawings must be as near right as I know how to make them, whether made by our best draftsman, or one of the apprentices, and in this way I manage to get the work through the shop in a very satisfactory manner, as well as keep a record of each man's ability.

I realize that a good many of the mistakes a man makes are careless ones, and do not always show for his best ability in every way, yet all mistakes entered on the card keep the most important record, and a close, observing chief can judge the rest of the man's ability when the time comes to raise his salary. CHECKERS.

Another Crank-shaft Repair

I am going to inflict another crank-shaft story upon your readers and hope that the old timers who have done the same job dozens of times will skip this article and not attempt to prevent the boys from reading it.

The crank-shaft, about 9 inches in diameter, was loose in the disk at *B* and there was not a piece of steel in town large enough to make a new one, but the job was done and is still running satisfactorily.



THE CRANK-SHAFT

After removing the old shaft from the disk it was put in the lathe and a taper hole bored in the end 6 inches deep, 1½ inches diameter at the small end and 1⅝ inches at the large end. A taper plug *E* was then made 7 inches long, 1⅝ inches at the small end and 1¾ inches at the large end.

The next move was to send the shaft to the blacksmith shop, where the end was heated to a bright red, almost white, and while in this state the plug was driven in with a ram. While this was going on, the other part of the shaft was put in the lathe, the end marked *D* in the chuck and the part marked *C* in the steady rest; the hole marked *B* was then trued up.

As soon as the shaft was cold it was centered and turned to fit the hole. A key was made and carefully fitted and the shaft pressed in at about 90 tons.

The joke in connection with this job was that the owners claimed that we had spoiled the engine, and brought over an indicator card in support of their assertion. This card was certainly a bad one. On investigation, however, it was found that the card was taken with the cord leading off at an angle of about 45 degrees from the crosshead and when their attention was called to this fact we heard no more from them.

SENEX OCCIDENTALIS.

The Specialist versus the All-Around Man

What is all this argument about specialists and all-around men anyhow? If there is any chance for argument it is a new one to the most of us old timers who have lived for a decade in the shops. Do those who know how to run a lathe, or milling machine mean to say they are the wise ones? We who have studied the whole thing from the pattern shop to finished product, sometimes just for the mere sake of knowing how, but often because it was up to us and the goods had to be turned out, are foolish to waste our gray matter that way when we might have learned a new soltaire game, or become proficient in a difficult billiard shot. Of course it takes all kinds of people to make this world, and if all were ambitious there would be a hard time for the lieutenants of industry sitting on the lid to hold them in.

Taking my own case, not so many years ago I was a well paid specialist and fairly well satisfied with my lot, but reading the AMERICAN MACHINIST and hearing the smooth talk of the correspondence school man started me and my discontent never let go. First I took $1 per day less to go to work in a little 2½-horse-power shop where they would do any kind of a job which could be brought into the yard; nothing too fine or too rough to get action there.

The next place was an experimental "laboratory." I stayed there until the money began to get low, and then found a working foreman's job in another all around shop. This was one of the kind where general repair work as well as experimental work for inventors, amateurs, etc., was handled. One job might be a model pedometer, and the next a repair job on a stone crusher; we took them as they came, worked nights to repair broken down engines and Sundays to fix up electric motors. When we could not get the job to the shop we could go to the job.

These are the kind of experiences which cause a man to think for himself; the work has to be done and there is no cut and dried method nor kind foreman to show the way; just get it done and done right.

Yes, friend Specialist, this is all harder work than hanging around your machine, and putting in a piece once in a while. Sometimes I have wished myself back, especially when I have had to stand all day and scrape lathe beds or surface plates. That is real work, but it puts tone into the muscles of one's good right arm and gives a healthy appetite. The know how is also

acquired, as can be done in no other way. A man who has originated a few sets of surface plates always has more respect for them than the man who uses bought ones, unless he pays the bill.

Specialist asks what I have gained by all this exercise of brain and brawn. In the first place, both are stronger, and I have worked along with various specialists since, and never at any disadvantage except to them. Jack may know just what that lathe he runs so industriously can do. I know how to find out mightly quick what *any* lathe can do, also how to show the lathe hand if he doesn't know, and without hurting his pride either.

What would Jack do if, instead of having his lathe all ready for him when he was hired on a job, he found the lathe on skids and the line shaft and hangers on the floor? Could he or would he put them up, *and do it right?*

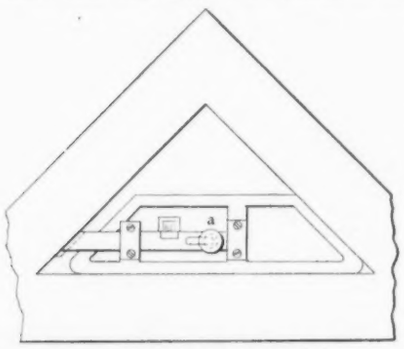
What does he do if anything goes wrong with his lathe? Call for help, like most of the craft, or can he muster enough energy to pull it apart and dig the chips out of the crossfeed gears? A good many of the present-day specialists would have to take a day off while a toolmaker (another name for an all-around man now often misapplied), does the work for him.

When it comes to milling, he would get lost, when skilled (?) toolmakers shift the index plate on the dividing head. Because the index table says 6 26/39 is the correct thing for spacing six divisions, they won't believe it, nor will they in some cases, when told 6 12/18 or 6 14/21 would do just as well.

Specialists may be all right, but give me a few all-around men for doing things which require thinking, and I will guarantee to educate the specialists who are to handle the cut and dried work on lathe, miller, grinder, etc. CY CLOID.

A Section Liner

About two years ago there appeared in the AMERICAN MACHINIST several ideas for section liners. Perhaps it would not be out of place to publish another for the benefit of new readers. The section liners that were given were similar as regards moving inside the 45-degree triangle, but were not graduated, whereas the accompanying sketch shows one that is graduated. It can be made in wood or metal but if made in metal it will require gutting, as shown, to lighten it: It is graduated in 1/32 to ¼ inch, the ¼-inch graduation being useful for other purposes than section lining.



A GRADUATED SECTION LINER

Referring to the sketch, it will be seen that two brackets are screwed to the frame for the bar to slide in. The bar is bent down at the end to press against the triangle but just miss the paper. When set to the required dimension it is fixed by the screw *a*.

The advantage of the graduated section liner over those that appeared formerly, is that there is no guessing, as it may be readily set to any dimension required. The bar is filed thin where the pointing line is scratched so as to get close to the graduations.

In the sketch the section liner is set at zero and fits closely inside the triangle. It is used in conjunction with the T-square and triangle, the triangle sliding against the T-square. When using it the thumb is pressed on the T-square, the fingers being used to move and hold the triangle and section liner. When set to the required dimension it is placed inside the triangle and pushed gently against the right-hand edge. After drawing the first line the triangle is pushed against the section liner and the next line is drawn and so on. With a little practice it can be operated very quickly and quite easily.

Beeston, England. A. J. W.

"Curing a Hot Bearing"—Why Draw-filing is Efficacious

In answer to A. Miller's question at page 642 as to draw-filing a bearing I wish to say it is good practice, but few people know about it and fewer know why it is done.

A journal is not supposed to touch the bearing but roll on the globules of oil (which are very small balls of oil) in much the same manner as it would if the bearing were full of small steel balls. The fine lines that are made by the draw-filing causes the globules of oil to fill the space between the lines the length of the bearing and stay there, making a bearing something like a roller bearing. If the pressure is so great per square inch of bearing as to break the globules then the two metals will come together and cause friction. The way to cure that is to provide more bearing and journal area.

J. J. GOODRICH.

Curing a Hot Bearing

Answering A. Miller's inquiry at page 642, regarding the hot bearing, I would say that it is better to have tool marks at right angles to the direction of movement than parallel to it. There need not necessarily be any tool marks on the work. The journal and bearing should be to a good bearing, i.e., true, so as to allow a film of oil between the moving parts making a metallic contact impossible when properly oiled. Such a bearing will not heat.

When tool marks are at right angles to the direction of movement the parts will at once begin to wear to a perfect surface which they would otherwise not do.

The fact that bearings and journals under such conditions, wear appreciably is due to not being oiled to such an extent as to form a film between the moving parts at all times. The film may exist when the oil is applied but wears away before the next application.

M. B. STAUFFER.

Spiral Gears with Shafts at Right Angles

The following information may be useful—and new. Taking formula (6) given by Mr. McCabe at page 464,

$$c = \frac{n_1 \sec.\theta + n_2 \sec.\phi}{2P},$$

where c is the center distance, P the diametral pitch, n_1 n_2 θ and ϕ the numbers of teeth and the angle of pinion and wheel: put $\frac{n_2}{n_1} = R$ and substitute for ϕ its value $(90 - \theta)$ and we get

$$c = \frac{n_1}{2P}(\sec.\theta + R\cos.\theta).$$

Assuming n_1 and P to be constant, we find, by calculus, that c is a minimum when $\tan.\theta = \sqrt[3]{R}$. From this we are able to calculate what angle would give the strongest possible pitch or greatest number of teeth for a given center distance.

When a good many spirals at right angles and fixed centers are to be worked out, as in a gear-cutting shop, the following method, which I have used for some time, may commend itself:

Using the formula

$$c = \frac{n_1}{2P}(\sec.\theta + R\,\mathrm{cosec}.\theta),$$

take $\frac{1}{2}(\sec.\theta + R\,\mathrm{cosec}.\theta) = M$.

Values of M for the minimum case and for a range of values of θ (say from 15° —75°) are now taken for the more common values of R and a table made. We then have

$$c = \frac{n_1}{P} M.$$

To use this simple formula (given say the ratio R, the pitch P and the distance c), observe what numbers of teeth will give the nearest value to M minimum. Calculate the true value of M and, taking from the table the two neighboring values of M, find the true value of θ by interpolation.

It is always best to take n as the number of teeth in the pinion and of course R as the ratio $\frac{\text{teeth in wheel}}{\text{teeth in pinion}}$. All other

particulars are straightforward calculations from the value of θ.

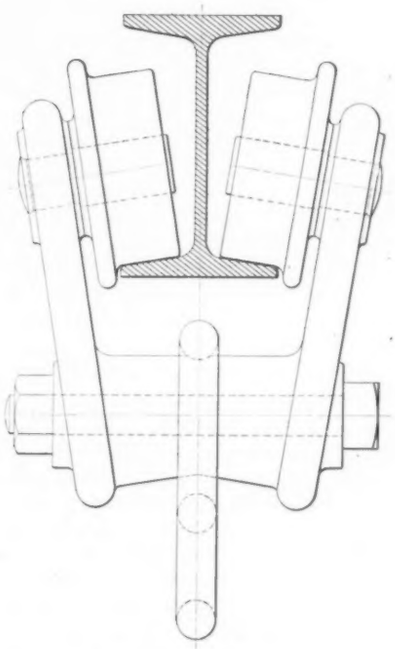
This method is the sharpest and simplest I know (unless, of course, one of the diameters happens to be fixed in advance). J. BUTTERWORTH.

Rochdale, England.

An I-Beam Trolley

At page 551 there is a description of an I-beam trolley which appeals to me as one of Professor Sweet's examples of "things that are usually wrong."

Since the roller is larger at the outer edge of the flange than it is at the web, there must be a certain amount of slip-



AN I-BEAM TROLLEY

page when the trolley travels along the beam, thus causing friction.

I submit a sketch showing a better arrangement of rollers, in which the axis of the roll is parallel with that portion of the flange on which the roll treads, thus making a rolling cylinder instead of a cone.

W. HOY BRADLEY.

"A Home-made Hydrostatic Level"—The Water Method Applied in the Leveling of a Planer

The article at page 635 on a home-made hydrostatic level reminds me of a method I used for leveling a planer some years ago. It was in a new shop and as they had only an ordinary carpenter's level which was not true, the foreman had us raise the platen clear of the ways, which we held in that position by laying blocks of wood between the bed and platen several feet apart. We then got some pipe and elbows with which we conpected both ways by placing clay around the pipe; we also stopped up the other end of the ways with clay.

Water was then poured into the ways and after it had assumed its level we took a depth gage, which we tried along different points of the bed. At points where the water was low it showed that the bed was high.

The reason we used a depth gage was that we were enabled to measure in the center of the ways; we could not measure at the edge because the liquid would not form a sharp line owing to the fact that the ways had been oiled.

I have since then used the same method and afterward tested the planer with one of the best levels that can be bought and found the planer to be perfectly level.

CINCINNATUS.

"Tempering Novo Steel with Cyanide"—Cyanide on Carbon Steel—Another Hardening Mixture

Allow me to add a few words to what has been said on this subject. I would like to distinguish between the case-hardening effect of cyanide on a carbon steel (or tool steel), and the "paint" effect of a coating of cyanide on the surface of a tool during a short but very hot season of tempering. The instances where cyanide is an advantage for its case-hardening effect are, I think, comparatively few, and confined to those cases in which either one or both of the surfaces at the cutting edge cannot be ground after hardening.

AVOIDING SCALE

But instances where it is an advantage to protect the surface of a tool from the oxidizing effect of the air while hardening are, in my opinion, more numerous. The scale that begins to form just the moment the piece is hot enough to show straw color, and keeps on forming so long as the piece is hot and exposed to the air, is a thing to be avoided in many cases. In case a tool is ground all over after hardening, it makes but little difference how much scale forms.

APPLYING THE CYANIDE

In using cyanide I think best to put it on sooner than Mr. Ashley suggests, at page 216, or just about as soon as it will stick and melt. By putting it on sooner you are not "burning" your steel while playing with the "dope." Nor would I use it so generously that it would be found hanging on in large chunks after the show is over. Brush off all that you can conveniently get off just as soon as it has melted, and wet the surface, then after this you can give your whole attention to heating and dipping the piece.

A SUBSTITUTE FOR CYANIDE

There is another reason why cyanide should not be used indiscriminately. It is very poisonous and it is well, perhaps, that toolmakers are somewhat prejudiced against its use. I have used a substitute for cyanide which seems to take its place and is not such a deadly poison.

Take eight parts yellow prussiate of potash; eight parts of common salt; one part bi-chromate of potash; mix, dry and pulverize.

WHY SOME TOOLS WILL NOT HARDEN

Probably some of those mysterious cases where good tools made of good steel would not harden might be explained by the fact that the toolmaker had handled the tool with sweaty hands, wiped it over with dirty waste, possibly containing some soap, and after all this supposed the piece was clean. Take such a piece into a plating room to be plated, and you may see it go into a hot potash tank, a water tank, a cyanide tub and another water scrub, all to clean it. RIGGS.

How to Check Nuts

The following useful nut checks are to supplement those given at pages 214 and 514.

Nuts that are subject to considerable vibration on gun carriages are often locked by slightly riveting the end of the bolt over on to the nut when it is screwed home. This is preferred by many military engineers to other methods

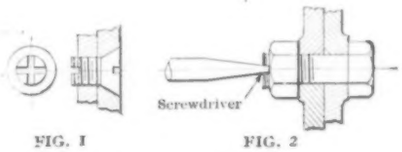


FIG. 1 FIG. 2

NUT AND SCREW CHECK

as being more reliable and neater in appearance; it also does not prevent unscrewing the nut if necessary.

Fig. 1 shows how the smaller size screws used in the overhead fittings of electric tramways are often prevented from unscrewing; this method is equally applicable as a nut lock. Bolts are used having two saw cuts 3/32 inch deep at right angles, in the end of the thread, which projects 1/16 inch beyond the nut. The ends of the screw are slightly spread by the insertion of a screwdriver in the saw cuts after the nut is screwed home. This method, shown in Fig. 2, proves very reliable in practice and is suitable for bolts and nuts up to ½ inch diameter.

Bristol, England. A. F. C.

The editor would like to know if there is anywhere a tool room, in which when the drawings are made for a new tool or appliance the toolmakers are required to submit an estimate and are then required to construct the tool within the estimate.

THE FIFTY-FOURTH MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

In accordance with the program previously announced, the above named society convened in the auditorium of the New York Edison Electric Company, at 8:30 p. m. December 4, with President Frederick W. Taylor in the chair. The president in opening the meeting called attention to the very full program to be followed and suggested that it might be well for the society to adopt a rule limiting the discussion of any subject brought up at a business session of the society to five minutes' occupancy of the floor by any one member. A resolution was offered to that effect, and adopted.

Following this was the appointment of tellers of the election of officers. The tellers prepared their report during the presentation of the president's address, which was presented in abstract only. We present herewith our own abstract previously prepared.

Annual Address of the Retiring President On the Art of Cutting Metals

By F. W. Taylor

The address of President Taylor is a monumental piece of work, of which its mere size is perhaps the most inadequate indication of the labor behind it. Nevertheless, we give this size as 248 pages with 24 large folded plates.

The address is a summary of the immense amount of research undertaken by Mr. Taylor with several associates (to whom he gives very generous acknowledgment) in trying to find a complete answer for the three questions which occur with every piece of machine-shop work, namely, what tools shall be used, what cutting speed shall be used, and what feed shall be used? The reply given to these questions is, however, a reply for roughing work only, finishing cuts not being touched in the paper.

THE BEGINNING OF THE EXPERIMENTS

Mr. Taylor explains that in the fall of 1880, when engaged as a foreman of the machine shop of the Midvale Steel Company, he found himself in need of information on this subject, and with the permission of the company he began a series of experiments, expecting them to last about six months, although with the exception of a few comparatively brief periods they have continued until the present time through a term of about twenty-six years.

Mr. Taylor points out that the answer to the questions involves twelve elements or variables, and he explains that his solution has been obtained through (a) a series of experiments for the discovery of important facts or laws connected with the art of cutting metals; (b) the finding of mathematical expressions for these laws; (c) the investigations of the limitations and possibilities of metal-cutting machines; and (d), the development of a slide rule by the aid of which the laws discovered may be applied.

SCOPE OF THE EXPERIMENTS

The experiments begun at the Midvale Steel Company have been continued at various other places, the method of obtaining the necessary facilities for the experiments being by disclosing the results of previous experiments in exchange for these facilities. As an indication of the vast scope of the work it is stated that between thirty and fifty thousand recorded experiments have been made, in which more than 800,000 pounds of steel and iron have been cut into chips, the total expense to date being estimated at between $150,000 and $200,000.

The course of the experiments has been marked by a series of well defined discoveries, eighteen of these being given in chronological order, the most important of them, however, being stated to be the reduction of the mathematical work to the slide-rule basis whereby its practical application is made feasible. The preliminary reduction of the experiments to mathematical expression was the most baffling feature of the work, several mathematicians to whom the data were submitted having returned them as incapable of mathematical expression.

THE METHOD OF EXPERIMENTING

The author points out the necessity for that system of experimenting by which all elements except one are held constant and uniform, the one exception being systematically changed and its effect upon the problem carefully noted. He returns to this subject again and again and points out that through failure to observe it most of the experiments which have been made upon this subject have but limited value. Another feature in which he reverses the methods of most other experimenters lies in the fact that he regards the best measure of the value of a tool to lie in the cutting speed at which it is ruined at the end of a definite period of time, this period being taken at 20 minutes, instead of the reciprocal measure which other experimenters have used by which the cutting speed is kept constant, and the value of the tool is estimated by the length of time which it will run before being ruined.

ELEMENTS WHICH HAVE BEEN NEGLECTED BY OTHERS

Elements which have been neglected by other experimenters are the effects of cooling the tool by a heavy stream of water upon it, by which a gain of 40 per cent. in cutting speed is obtained, and the effect of the contour or outline of the cutting edge of the tool upon the cutting speed, which, with a properly shaped tool, again results in an equally large percentage of gain. While the neglect of these points, together with the fact that variations in two or more variables were studied at the same time, largely vitiates the value of previous experiments, nevertheless the author concludes that a good deal of value has been disclosed by such other experiments. He refers also to the second set of experiments by Dr. Nicolson on the pressure of the chip or shaving upon the cutting edge of the tool, which he regards as the least fruitful of all experiments in this field, since he finds that there is no traceable relation whatever between the hardness of the metal and the pressure upon the tool.

DISCOVERY OF THE EFFECT OF HIGH HEAT

Mr. Taylor then describes the experiments by himself and Mr. White on heating tools of self-hardening steel above the usual point, and the wholly unexpected discovery that such overheating if carried beyond a certain point improved the performance of the tool, and later on he points out that the discovery which is usually ascribed to himself and Mr. White, of the composition of the modern high-speed steels was in reality no such discovery at all, but simply the discovery of the effect of over-heating on then existing steels, which were capable to a certain extent of doing what the modern steels do now.

Incidentally at this point of the paper the author gives an adverse opinion regarding individual motor drive of machine tools, saying that "in perhaps three cases out of four the properly designed belt drive is preferable to the individual motor drive for machine tools."

CONCLUSIONS REACHED

He then takes up in great detail the various phases of the subject which have been investigated, not all of which can be even mentioned in this brief abstract. He first discusses the action of the tool and its wear in cutting metals, and then under the title—"How to make and record experiments," he explains for the guidance of future experimenters the method followed by himself. He then takes up the proper shape for standard shop tools, recommending a few carefully considered types as preferable to a great variety, gives the elements affecting the cutting speed

of tools in the order of their relative importance, and from this goes on to discuss the lip and clearance angle of tools, his conclusion being that the most important consideration in choosing the lip angle is to make it sufficiently blunt to avoid danger of crumbling or spalling off at the cutting edge.

Next he takes up the forging and grinding of tools, discussing the size and proportions of the body of the tools, the importance of bending the nose of tools over to one side to avoid danger of upsetting, the reduction of the cost of forging and grinding to a minimum, and other phases of this subject. He then gives a section on the pressure of the chip on the tool, in which he reiterates his previous opinion that investigations of this subject are of little importance, saying that his principal object in writing at such length is to make it clear that a study of this element is comparatively barren of practical results, although it has been the subject throughout the world of perhaps four-fifths of all the experiments connected with the art. He analyzes the conclusions of English, German and American experimenters, and shows that they lead to negative and even discordant results, and concludes that no law can be established showing the relation between the cutting speed and the tensile and crushing strength of the metal to be cut.

Next he takes up the cooling of the tool with a heavy stream of water, a practice which has grown up entirely since his first experiments upon this subject; the prior use of water being in a dribbling stream, intended to produce the well known effect of a water-cut rather than to keep the tool cool. He then discusses the chatter of tools and the conditions which lead to it, and on this subject he considers the experiments of Professor Nicolson of special value.

Following this he takes up the length of time which a tool should run between grindings, and follows this with a section on the effect of feed and depth of cut on cutting speeds, his general conclusion being that more work can be done by using the combination of a coarse feed, with its accompanying slower speed, than by using a fine feed and its accompanying higher speed. In this section will be found some of the most practically useful of all his determinations in the form of tables, giving cutting speeds corresponding to different depths of cut and thickness of chip on hard, medium and soft steel and on hard, medium and soft cast iron.

THE DEVELOPMENT OF TOOL STEEL

The next section is on tool steel and its treatment, in which we find a chronological table of the development of tool steel, beginning with the best grade of carbon steel, followed by Mushet self-hardening, the original Taylor-White, and the best modern high-speed steels, the progress being marked by an increase of the cutting speed, under given conditions, from 16 to 99 feet per minute. In this section he takes up the treatment of high-speed steels and claims that no improvement has been made in the heat treatment of high-speed tools since the discovery by Messrs. White and Taylor in 1889 to 1899. Samples of those makes of tool steel which have recently obtained the highest reputation have been obtained and experimented with. Detailed instructions were obtained from the makers regarding the heat treatment recommended, and tools were treated in exact accordance with the instructions. Alongside of them tools from the same steels were tested after being treated in exact accordance with the methods indicated in the White and Taylor patent, and without an exception the tools when treated in accordance with this patent proved more uniform and ran at slightly higher cutting speeds than when treated in accordance with the directions given by the makers, and he concludes that little attention need be paid to the special directions given by makers of high-speed tools for their treatment.

THE COMPOSITION OF STEEL

The next section of the paper discusses the chemical composition of tool steel; the analysis and cutting speeds of many of the latest high-speed tools, and the comparison of these tools with Mushet self-hardening tools and the original high-speed tools of Taylor and White being given. The effect of the various elements entering the constitution of high-speed steel are discussed, and the best modern high-speed steels are compared with the original high-speed steel of Taylor and White. One line of improvement pointed out is the fact that whereas the original Taylor steel required two grades of tools for different hardness of metals, the modern steels do equally well with both hard and soft metals. Meanwhile, the cutting speed has been increased 50 per cent. and the new tools are more difficult of injury through carelessness in heating upon the grind-stone. Another improvement lies in the fact that the second heat treatment of the Taylor-White steel is less important on the later steels, although it still gives some improvement in the endurance of the tools.

The remaining subjects discussed are the theory of hardening steel, the effect of the quality of the metal being cut upon the cutting speed, in the study of which less success has been obtained than in studying the subject of tool performance upon material of a constant grade, the effect of the line or curve of the cutting edge on the cutting speed, and finally the slide rules and their uses.

Back of the speaker on the platform there had been erected a mammoth slide-rule, representing such as have been devised by Mr. Barth for use in connection with the work of the Taylor system and specifically in deciding the working conditions under which given pieces of work are to be done in the lathe, etc. This slide-rule was made of planks which had been painted and suitably graduated and figured to represent a given machine tool. At the conclusion of the president's address, he called upon Mr. Barth, who explained to the audience the construction and use of the slide-rule, and he solved by it several problems which were propounded by members of the audience.

ELECTION OF THE OFFICERS

At the conclusion of Mr. Barth's remarks, the tellers of election made their report which showed not only an unusually heavy vote, but also that the candidates on the regular ticket had been elected by a practically unanimous vote, notwithstanding the efforts that had been made by one member to defeat the candidate for president. There were 975 valid votes, of which Professor Hutton received 946.

The applause which greeted the announcement of the vote showed plainly enough that the membership present were practically unanimous in warmly approving it. President Taylor immediately appointed C. W. Hunt and W. R. Warner as a committee to escort the newly elected president to the platform, where he was introduced by Mr. Warner in a few well chosen words, and responded in a particularly graceful manner showing, however, that he had been somewhat affected by the magnitude of the vote cast for him, and by the evident warm sympathy of the audience with him. He frankly confessed that it would be a mere pose for him to assume that he did not feel the high honor that had been conferred upon him; that during the twenty-three years of his service to the society it had been his sole aim to act always in what he believed to be its highest and best interests. He assured the audience that his efforts as president would be along the same lines. At the close of his remarks he received what amounted to an ovation. The transfer of this part of the proceedings from the Wednesday morning session to the session of Tuesday evening was a variation from the usual procedure, which was adopted by action of the council and which seemed to work admirably, so much so that it is not unlikely to become the permanent practice of the society. There then followed the usual social reunion and luncheon was served on the floor below the auditorium till midnight.

WEDNESDAY MORNING'S SESSION

The regular business session of the society opened at 10 o'clock, the first announcement being the result of the canvass of the votes for members by the tellers of elections. The secretary stated that the maximum number of black balls that had been cast against any one candidate was only two. He thought this spoke very

highly for the careful work and scrutiny of the membership committee, and also indicated that the members themselves are now proposing men of high grade, and those in every way desirable as members. The entire list presented to the membership was elected.

The regular procedure was then gone through with regard to the proposed amendments for the constitution. No discussion was offered upon them, and they will therefore take their regular course toward adoption. We have previously noticed these amendments, which were presented at the Chattanooga meeting.

Mr. Bond, of the Committee on Standard Screws, reported that as a result of conferences with manufacturers of screws the committee had concluded that it would be wise to defer a final report upon that matter until the next meeting.

Several invitations were then presented by the secretary to visit various power plants, and other interesting places about the city, which invitations had been received too late to have been previously announced in the regular way.

ART OF CUTTING METALS

Discussion of the president's annual address being then in order, the president requested that members rising to address the chair should speak their names distinctly when recognized, so that other members, and especially the official stenographer, might know who were speaking. He then asked Mr. Barrus to take the chair during the discussion, and the secretary then presented discussion by several members, which had been submitted in writing. The first was from Henry R. Towne, in which he spoke in the highest terms of the quality of the paper, comparing the system which it treated with the invention of the sewing machine, the typewriter. These experiments of Mr. Taylor's, he believed, would raise the methods of cutting metals to the high level of a modern science, from the lower level of empiricism which the art had occupied. He believed the paper was the most important so far contributed to the transactions of the society, and referred to several incidental discoveries and achievements, such as the management of driving belts, the forms of tools, and the invention of a slide rule, making use of 12 variables, reducing it to a form to be used by almost anyone. All these achievements, the speaker believed, were of great importance, notwithstanding they were mere incidents to the general and larger work that had been carried on during 26 years by the president and his associates.

The new secretary, Calvin W. Rice, spoke in the highest terms of the paper, speaking particularly of his observations in a bleachery in Rhode Island, where he had been privileged to see the result of the application of the system which had been devised by Mr. Taylor, and in which establishment, as an instance of what had been done, he had been shown the cost of doing certain work before the introduction of the system and after its introduction, and where the work done at a given expenditure had been increased fivefold and wages were considerably higher than before.

Daniel Adamson, of England, who was identified with the experiments of the Manchester committee on the cutting of metal, called attention to some criticisms of that work which had been made in the address and thought that nevertheless, considering the fact that the Manchester commission had done its work in very much shorter time, with necessarily very much less preparation, and with almost no previous experiment or public record of results previously made, the agreement between the results obtained by the committee and those obtained by Mr. Taylor was remarkable. He defended the general methods followed by the Manchester committee, and criticized the deficiency of data contained in the address which others could follow. He also referred to the criticism in the address of certain features of machine tools and said that the conclusion to be drawn from this statement was very different from that which would be drawn from the articles to be found in the technical press. He called attention also to the fact that nothing was said in the address as to the hight of the tool with respect to the center line, and seemed to think that this was an important factor.

Another English participant, connected with the firm of Vickers, Son & Maxim, also referred to this omission, evidently believing it to be important, and also said that there seemed to be a difference in the speed at which a given tool could cut when working on a diameter of work, say of 12 inches, and the same quality of metal at 6 inches diameter. He did not pretend to give the reason for this, but believed it might be because the advancing chip was made to approach the tool at a different angle, and that at the larger diameter the conditions were more nearly like those of planing, and the tool was better adapted to withstand the stress. He called attention also to the fact that if, as Mr. Taylor insisted, the force that could be applied to the tool by the feed motion should equal that which could be applied to driving the work, then the section of the tools used should be square, so that they might have equal strength in both directions. He called attention to the fact that in the Manchester experiments such tools had been used.

John T. Hawkins regretted what he referred to as the emasculation of the mechanic which would seem to follow from the adoption of the system of shop management indicated in the address. He expressed his sympathy for the high-class, intelligent, thinking, all-around mechanic, who had been the chief instrument in the development of our industries, and while he recognized the necessity for the development of the specialist, he regretted to see the adoption of any system of working which deprived the man doing the work of the opportunity for thinking of his work, of becoming intelligent regarding it, and of acquiring and utilizing what he referred to as "finger wisdom."

Mr. Taylor at this point announced that there were in the hall at the time about fifteen men who had in various shops, particularly in Philadelphia and in Stamford, been the kind of men with whom Mr. Hawkins had expressed his sympathy, but who had been developed into competency for the management of work performed under this system, which had not in any way interfered with their development, but on the contrary had stimulated such development, as they themselves were ready to testify. He objected to the idea that men are restricted in development by his system, but insisted that they were given by it the best opportunity for higher development.

Frederick A. Osborne, of Sheffield, referred to the development of Mushet steel, saying that Mr. Mushet in 1868, in experimenting with bars of steel, accidentally made a discovery which led to his invention of tungsten steel, and from this he had gone on experimenting in various ways, including the heat treatment of steel, though he had not carried his heat to as high a degree as had been done by Messrs. Taylor and White. He had often said, however, "Mushet steel is a sleeping giant which will some day awake and perform wonders." The impression to be derived from Mr. Osborne's remarks was to the effect that Mushet had nearly attained what had been attained by Messrs. Taylor and White, so far as high-speed steel is concerned, though he had not gone quite far enough with his experiments to completely attain it.

M. Le Chatelier, of Paris, spoke of the exceedingly scientific methods pursued in doing the work referred to in the address, discussed certain points concerning the chemical composition of the steels used and referred to the most important points which have been developed by Mr. Taylor in respect to this chemical composition, and that is, the effect of vanadium.

Prof. L. B. Breckenridge, whose work along the lines of experimenting in the cutting of metal had been referred to in complimentary terms in the address, spoke in very high terms of the paper, and of the work done by its author, after which Dr. W. T. Nicholson, under whose immediate direction the experiments of the Manchester committee had been conducted, and who had afterward conducted some experiments on his own behalf in the cutting of metals, expressed his belief that we were under a debt of gratitude to the author of the paper for the infor-

mation he had given regarding his work, and believed that it threw an important light upon the question of the relative advantages of forging closely to size so as to make only the light cuts necessary, or of forging only approximately, and then depending upon the lathe or other machine tool to remove the surplus metal. He believed, however, that the address was in error regarding the relation between the thickness of the chip and the area of the chip, and believed that the results of his own experiments had not been discredited, calling attention to the close agreement between the results obtained by himself and by Mr. Taylor, the difference in some cases being only 1 per cent. He objected, however, to the author's method of combining high praise with severe criticism, and declared that, after all, the methods followed by the speaker had been essentially the same as those followed by the Manchester committee and by himself.

Mr. Hathaway called attention to the fact that before anything could be done toward utilizing the benefit to be derived from the method of working metals indicated in the address, the conditions favorable to such methods would have to be secured. In other words, you must not only have answers to certain questions which he specified, but you must be able to make use of these answers when obtained. He gave a vivid description of the efforts of a foreman in trying to increase production without such an organized system, this evidently being based upon an intimate acquaintance with the way such things usually go. He believed that in this case it was emphatically true that an ounce of prevention is worth a pound of cure, and that before the various difficulties which arise in an attempt of this kind can present themselves, they must be provided for in advance. The speaker had left the Midvale establishment in which work was being done in accordance with the system referred to and had gone into the management of a smaller concern where he was amazed at the light cuts being taken and the general inefficient methods followed, although it was believed that these were not inferior to the average machine-shop practice. Unfortunately this system could not be bought and delivered in a box; it had to be instituted by an experienced, careful man who could take time to thoroughly study the conditions under which the work was being done and under which it might be done. When this was done, the speaker believed it could in every case be made wonderfully successful.

Henry L. Gantt spoke of his experience of twenty odd years in setting tasks for machinists. Without exception they had been doing work much below the capacity of the machines operated—on day work usually about 1/3 of what could easily be done, and on piece work usually about ½. The system of working he declared attracts capable men, and he emphasized the importance and value of facts as compared with opinions, believing that the first important thing was to ascertain certain facts bearing upon the problem and to obtain these acts by properly conducted experiments. He had never known a case in which such investigations had failed to pay handsomely.

Oberlin Smith spoke of the importance of cutting speeds in the general efficiency of the machine shop, and related a case in which he had seen, in a prominent shipbuilding establishment, the cutting of mild steel at the rate of six feet per minute, and he declared that this had been going on indefinitely. He also referred to his own experience in arranging machine tools to be driven by motors and as in most cases these had been built to be be driven by belts, he had found the belt the most practical way to continue this drive and had found that by using a thin, though necessarily short belt, as wide as practicable, and running it at very high speed, up to say 3000 to 5000 feet per minute, he had been able to easily get all the driving power required to drive the tool at its full capacity. His belt had also been endless, i.e., with cemented joints.

W. S. Huson referred to the experiments described as relating almost entirely to heavy work; in fact it was what was sometimes referred to in the shop as hogging away metals. The speaker was interested in printing-press manufacture and referred as an instance to the planing of type beds, which he said were thin castings, in which the chief problem was to get a tool which would deal with the scale upon these castings and to plane them in such a way as to cause a minimum of subsequent work in bringing them to the required degree of accuracy. He believed that carbon steel was as yet by no means a back number, and that where accuracy was to be secured and in fact some attention given to other things beside the mere amount of metal removed within a given time, these carbon steels were yet useful in machine-shop manipulations. He spoke of the difficulty also in milling work accurately, and said that in certain grinding operations, the grinding wheels seemed to peen particles of metal into the surface of the iron, so that changes in it took place subsequent to the grinding; cases being related in which the indicator would show the piece to be accurate and true immediately after the grinding but that a short time subsequent thereto it would be found out of truth.

James M. Dodge regretted the use of the term "task" in connection with the system. He said this was used owing to what seemed to be a limitation of the English language. It was recognized by Mr. Taylor as well as by himself as being not quite the word, though perhaps it was the best that could be used. This system he declared was not a whip or club applied to make the men do more work. It *enabled* them to do more work, because it improved the methods by which they did the work, but in many cases it lightened the actual labor performed by the workman. It cuts out unnecessary motions, and from the men themselves, he had the testimony that under this system they went home less tired than when working in their own way. It is not, he declared so much a task as a help, and might more properly be referred to as the comfortable possibility of a workman. Professor Kent said that he had heard a word used among college boys, which perhaps would fit the case better; that word was "stunt."

There being no further discussion, the author in conclusion said that he and his associates had been overwhelmed by the attention the paper had received. He had also been much surprised at what appeared to be the necessity for the length of the paper, having had no idea when he commenced work upon it that it would be necessary to include so much material and to discuss so many co-related matters. He believed that the system to which the paper related might be a means of raising wages all over the country by about 30 per cent. He believed also that Mr. Nicholson and Mr. Adamson had misunderstood his object in criticizing the experiments made under their direction. He called attention to the fact that he had criticized his own work much more severely than that done in Manchester, and believed that where one word of criticism of the Manchester experiments could be found in the paper, there would be ten words of criticism of his own experiments. The criticisms made were certainly not intended to offend and it was certainly not believed that they would offend; but he believed it was important to call attention to the fact that where, in experiments, two or more variables had been introduced, as had been done at Manchester, a serious mistake had been made in spite of the valuable results which had been obtained and for which he had given full credit. He believed it was necessary to call attention to this feature of the experiments at Manchester in order that such mistakes might not be repeated by future experimenters.

He believed that if Mr. Huson would cast, say 20 type beds, which are to be assigned ultimately to the scrap heap; if he would then go systematically at work experimenting with these 20 castings with a view to seeing how rapidly they could be machined; if this work was done intelligently and carefully by Mr. Huson, himself, or by someone interested in getting the best results and without prejudice against new methods; if he would be willing to spend, if necessary, six months in this work, in other words, to pay the price of obtaining the desired knowledge, that it would be obtained, that a method would be found of machining them much more rapidly than was now done, and that

the results would be of the highest value. Similar things, he said, had been encountered thousands of times, in the course of their work. Men had told them, "You may do the work of others to advantage, but you cannot do our work." He had been told that it would not apply to locomotive work; he had been told that it would not apply to fine work, in which the limits of variation were as fine as 0.001 inch, or in some cases, 0.0001 inch; nevertheless on such work a way had been devised of doing it ten times as rapidly as had formerly been done and he believed that there was no class of industrial operations to which the system could not be applied with the utmost advantage; the experience of 26 years seeming to most conclusively bear out this belief.

WEDNESDAY AFTERNOON'S SESSION

The Evolution of Gas Power

By F. E. Junge

This paper is not so much a discussion of the evolutionary process through which gas engines have gone in the past as a statement of the present line of development, and a forecast of what may be expected in the future.

The author points out the importance which gas power has already attained by saying that in Germany, having four-fifths the area of Texas, there are already installed or in contemplation gas engines aggregating 420,000 horse-power, of which the average horse-power exceeds 1000.

He points out the necessarily sporadic nature of the early period of growth of innovations of this general character and he instances the Diesel engine as an example, since it has made but slow progress, although on its appearance the conclusion was general that it was a truly wonderful invention. The Brayton engine of 30 years ago is also given as an invention that was hopelessly ahead of its time.

In connection with the present outlook, it is pointed out that a drawback which cannot be overcome is the lack of overload capacity in gas engines which often militates against their adoption. For this reason, for service with heavy overloads, the capacity of gas engines must be considerably larger than that of steam engines.

The subject of the higher initial cost of gas engines as compared with steam engines and the consequent higher fixed charges is discussed. The cheaper the fuel the less profitable becomes the use of gas power, and at a certain price per ton of coal the economical advantage of gas engines disappears. Curves of these relations have been plotted which originally showed the economy of the two motors to be equal for coal at about $2 per ton, but this was soon reduced to $1, and it may eventually be reduced to the zero point.

This side of the subject has, however, entered an entirely new phase since it became possible to gasify fuel which cannot be efficiently used for raising steam under boilers, and this leads at once to the subject of the producer, which has helped to give the gas engine the field of application which it is just beginning to enjoy.

Reference is made to the fuel tests of the United States Geological Survey on inferior fuels and the statement is made that in Germany producers are in successful operation on such material as city refuse, culm banks, etc., containing not more than 20 per cent. of combustible matter, and yet they are doing continuous service. This possibility of using fuel for gas engines, which has heretofore not been employed at all, reverses the position of the two engines when using the cheap fuel.

Taking up the gas engine as a utilizer of by-products, it is pointed out that with by-product coke ovens, every ton of coke per 24 hours gives five or six available horse-power in gas, which would give for the coke production of the United States, one and one-half million horse-power, while the surplus gases from the blast furnaces of this country would generate about two and three-quarter millions of horse-power, if utilized in gas engines. Another feature of gas power obtained through the producer is the elimination of smoke from power houses.

The portable suction-gas plant is coming into considerable use among German farmers, the fuel used being straw, sawmill refuse, etc., the power being thus obtained with little or no cost for fuel.

The advantage of producer-plant gas engines for ship propulsion is pointed out. Several such applications have been made in Germany, one concern having equipped eleven vessels. The saving in cargo space effected in a 7000-ton cargo ship was found to be 13,000 cubic feet. Competitive trials of tugs fitted with gas and steam engines have shown a consumption of 530 pounds for a 70 horse-power gas-engine tug against 1820 pounds for a 75 horse-power steam tug.

Finally it is pointed out that the gas engine "has not only extended the capacity of our fuel resources to double or more of their former value, but has also enabled us to profitably utilize material and property which was deemed utterly worthless even a few years ago."

The discussion was opened by Professor Carpenter, who considered the paper a valuable one. He referred especially to the Brayton engine, of which the cycle was essentially the same as that of the Diesel. Mr. Brayton built his first gas engine in 1872, and his first oil engine in 1874, one of his oil motors having been shown at the Centennial Exposition. One of these motors was used by Professor Anthony in a lecture at the Cooper Institute in 1875, where it was used to drive the first dynamo having the Gramme ring armature made in this country. Mr. Brayton also applied his engine to the propulsion of boats. He died in 1893.

Mr. Ennis doubted the figures given for the comparative cost of steam and gas power. In this country the efficiency obtained for the producer is not equal to that obtained with the steam boiler, and such thermal efficiencies as those named have not been obtained here from the gas engine. Regarding the outlook for the steam engine it must not be forgotten that in exceptional cases as good results have been obtained from the steam engine as from the gas engine.

Mr. Hellmund remarked that electrical engineers are disposed to avoid the gas engine. He considered that in its present condition there is no reason why the gas engine should not be used in direct-current plants, but there are still reasons for avoiding it in alternating plants.

Professor Dieterichs considered that the possibilities of the Brayton cycle have not been appreciated or realized.

J. E. Johnson, Jr., referred to the blast-furnace phase of the situation, and touched upon the possibilities of transmitting combustible gases at pressures sufficient for direct use in the Diesel engine without further compression—the efficiency of such transmission being much higher than is generally believed. He objected to the author's statements regarding the wastefulness of furnace plants without gas engines. Blast furnaces have had closed tops, and have utilized their gases for forty-five years. Formerly this utilization was not economical, but for ten or fifteen years high-grade steam plants have been used. It is no longer possible to compare the gas-engine plant with the old type. The benefits to be obtained with the gas engine in blast-furnace plants may nearly all be obtained with first-class steam engines, and he warmly objected to the idea that the finger of scorn can be pointed at the metallurgical engineer because he has not made wider use of the gas engine.

Mr. Rathbun considered that overload capacity in gas engines is a necessity. Manufacturers are disposed to rate the capacity of gas engines near the top because of their high efficiency at full load, but he believed that the lack of overload capacity may yet be removed from gas engines, and that their efficiency below maximum load will eventually be greatly increased.

Mr. Wood submitted a mathematical discussion and expressed the opinion that the promise of the Otto cycle is superior to the Diesel.

Professor Fernald submitted a discussion in connection with which he exhibited a number of diagrams on the screen which summarized some of the conclusions so far made as the result of the fuel tests of the United States Geological Survey.

Mr. Atwater did not agree with the author in the statement that coking coals had not been gasified, and he questioned

some of the other minor statements of the paper.

Mr. Mathot gave some points from recent European practice in building gas engines. The compression had been increased without materially increasing the initial pressure, but with a considerable increase of the mean effective pressure. The high efficiencies now obtained are largely due to the shape of the combustion chamber which he showed by a sketch upon the blackboard. Hit and miss governing has been given up and the regulation of the mixture substituted for it. He had been told that the slow progress of the large gas engine in this country was due to its heavy cost, and he gave comparative figures of the cost per horsepower of such engines in this country and in Europe. He concluded by showing the form of piston which has been developed in Europe for use with double-acting gas engines by which former difficulties have been overcome.

Professor Lucke considered that the paper gives too high an opinion of gas-engine power. When looked upon in a large way the large sizes of such engines must be given first place, and they have troubles of their own. Comparing gas with steam engines from the standpoint of the theoretical cycle, the superiority is unquestionably with the gas engine, but from a practical standpoint the mechanism of the two engines is of greater importance. He sketched the progress of the gas engine, beginning with the exclusive use of manufactured gas, and extending through oil until now when the machine is driven direct from coal. He referred at length to the adaptation of engines to their work. For a century engineers have been engaged in designing special types of steam engines adapted to special requirements, but this process has hardly begun with gas engines. Gas engines have been put out simply as engines for any kind of work, and gas-engine men have based too many claims on the single item of efficiency. Gas engines for special purposes have not been developed because gas-engine engineers have been wholly occupied in making machines that would run, and many mistaken applications of gas engines have been made because purchasers have expected too much from them.

The time consumed in this discussion had already been so extended that at this point it was suspended, although several other members had sent in their names as speakers.

The next paper taken up was on a

Producer-Gas Power Plant

By J. R. Bibbins

This paper is intended to call attention to the producer plant in connection with a gas engine as a source of power, and it does this by describing and giving the results of use of a Westinghouse plant of 450 kilowatt capacity, installed at the works of the Gould Manufacturing Company at Depew, N. Y.

While the plant has not been subjected to formal test, daily records of its performance have been kept, which show a consumption of from 2 to 2¼ pounds of coal per kilowatt hour, on an average load of half the rated capacity and on heavier loads as low as 1½ pounds. The thermal efficiency under these conditions is between 12 and 13 per cent., although the latest observations show even better results, namely 1.8 pounds per kilowatt hour, and an efficiency of 17.7 per cent. at the shaft and 16.3 per cent. at the switchboard.

The plant and its work are fully described, and such troubles as have been experienced are explained.

Following this came a paper on

Steam Turbine Characteristics

By Hans Holzwarth

The object of this paper is to point out characteristics for steam turbines similar to the indicator diagrams of reciprocating engines, considered as characteristics of their thermodynamical qualities.

It is pointed out that algebraical computations with the general expression

$$p \times v^n = \text{constant}$$

for the general law of steam expansion are complicated and that graphical interpretation is the only way to work with this law. Instead of constructing a diagram to represent the equation directly, the author constructs a logarithmical diagram, of which the logarithms of the different values of the steam pressure are used as ordinates, and the logarithms of the specific volumes as abscissas. The values are obtained from the logarithmical scales of the slide rule, and when plotted the diagram becomes for saturated steam a straight unbroken line for a certain value of n and for superheated steam a broken line composed of two straight lines joining at the point where saturated steam changes to superheated steam. The result is that the vertical geometrical distance between p and p_0 is directly a scale for the amount of available energy for expansion processes within these limits.

The author shows how the diagram may be used to obtain various results, but he points out that it cannot directly answer all the thermodynamical questions, and to make his paper complete he gives a turbine diagram, first suggested by Professor Mollier, of Dresden, Germany, and in an appendix he gives some specific examples to illustrate the practical uses of his own diagram.

The paper was discussed by Captain Sankey who submitted a diagram of his own and discussed its use.

The next paper taken up was on an

Improved Design of Boiler and Setting for Use with Bituminous Coal

By A. Bement

The principal objects in this design are the attainment of a perfect and smokeless combustion and the full utilization of the boiler heating surface. The boiler tubes in the lower row are inclosed by special tiles, forming a roof for the furnace. It is claimed that a uniform feed of coal is secured by the use of a horizontal chain grate, and this, together with the fact that the refractory tiled roof to the furnace gives the gases time to be thoroughly mixed together before they meet the boiler heating surface, leads to complete combustion and the absence of smoke. A full utilization of the boiler heating surface and the avoidance of dead corners and other portions not acted upon by the hot gases is attained by using more baffle plates than usual, and reducing the area of the passage for gases as the chimney is approached, thus making allowance for the reduction in the volume of the gas as it becomes cooler. The second and third tiers of tubes from the bottom are left out in order to provide a space for catching the dust, which may be removed through cleaning doors. With this style of setting it is necessary to have a strong draft and the author considered that the best results may be obtained by a combination of forced and induced draft, so that the pressure in the furnace is equal to that of the atmosphere. In the case of comparative tests made of two boilers with natural draft and with "balanced draft," the draft over the fire in the former was equal to 0.389 inch of water, and in the boiler with the "balanced draft" the total draft was 0.38 inch and the draft or pressure over the fire 0; it was shown that in the former boiler the furnace gases had 5.03 per cent. of CO_2 and in the latter boiler the percentage was 7.32. These percentages would have been higher only that each boiler had an opening at the bridge wall. Pictures are presented of several chimneys, showing the smokelessness attained by this plan as compared with the smoky chimneys where this arrangement is not employed.

Professor Breckenridge stated that his experience confirmed that of Mr. Bement that the tile-roof furnace with a chain-grate stoker appears to be a most satisfactory combination for the burning of many grades of Western bituminous coals without smoke and with good economy. For years it had been known that in order to prevent smoke the gases should not come in contact with cold tubes until after complete combustion has completely taken place, but boilermakers have made little effort to meet these requirements.

Mr. Ennis considered that the paper offered a remedy for conditions which are quite common. Professor Kent considered the setting shown to be a long step in the direction of smokeless combustion and of maximum absorption of heat by the heating surface of the boiler. He objected to the author's conclusion that the balanced draft insures complete combustion with a smaller air supply than

would be the case with induced draft only.

Mr. Abbot had no doubt that within a year or two boiler manufacturers will be glad to offer boilers designed substantially like the one Mr. Bement described.

Mr. Carey considered the usual setting of the water-tube boiler as bad as it could be. He regarded the setting described to be essentially the Heine furnace applied to the Babcock & Wilcox boiler. He did not regard the claims made for the balanced draft as entirely clear.

Mr. Bryant was unable to see any novelty in the design, the advantages of which had long been known in connection with long-flaming coals. The baffling arrangements were not new and had not been successful. Professor Jacobus concurred in the opinion that the setting involved nothing new. Mr. McLean considered the results given as worthy of note.

The next paper taken up was on

A High-Duty Air Compressor

By O. P. Hood

This paper begins by pointing out that the feature of pumping engines by which they have given exceptional duty performance, namely, the uniform load per stroke, is also possessed by air compressors, and the author then goes on to point out that the size which such machines have now reached, exceeding 1000 horse-power in the case of several plants at the Michigan mines, favors the most economical construction of such engines, and a high duty performance by them.

The paper then describes an air-compressor plant of the highest grade, built by the Nordberg Manufacturing Company for the Champion copper mine at Painesdale, Michigan. The engine of this compressor is of the quadruple-expansion type and was supplied under a guarantee of duty performance, the guarantee being that it should develop 180,000,000 foot pounds of work in the steam cylinders for each 1,000,000 heat units used, and that it should compress 9000 cubic feet of air per minute to a pressure of 80 pounds gage, at 76 revolutions per minute. The steam is supplied by water-tube boilers, and the guaranteed performance was for a steam pressure of 300 pounds. Difficulties were experienced in obtaining this pressure, and consequently the pressure was reduced to 250 pounds during the test.

The engine is of the highest type of engineering construction, with all modern means for economizing steam. The results of the test exceeded the guarantee, the duty in foot pounds of work developed per million heat units supplied to the engine being 194,930,000 foot pounds, which establishes a new low record for the heat consumed per hour per indicated horse-power in steam engines; being 9 per cent. lower than that used by the Wildwood pumping engine reported in 1900.

Mr. Moss criticized the methods of determining the volumetric efficiency of the air cylinders. He had found great discrepancies in tests by the method used, due to leakage of the piston, but knew of no published test in which other methods were used.

Professor Bull considered the results obtained largely due to the system of feed-water heaters. He considered the paper insufficient in some of its descriptions, although the results obtained are undoubtedly trustworthy as they are remarkable.

Mr. Lewis regretted the absence of figures regarding the capital expenditure involved, and referred to experiments showing smaller fractional losses in simpler engines which largely offset the increased steam economy shown. For this and other reasons there is a marked movement in England toward the use of two-cylinder compound engines in place of those having triple and quadruple expansion. He regarded the machine as a refinement which is unwarranted.

Mr. Saunders referred to tests which showed smaller steam consumption by simpler engines, using, however, the water consumption as a basis of comparison instead of the number of thermal units. He pointed out some remarkable features of the air cylinder cards, and questioned the figures for volumetric efficiency.

The next and last paper of the session was on

The Steam Plant of the White Motor Car

By R. C. Carpenter, Ithaca, N. Y.

Professor Carpenter first gives an illustrated description of the White steam plant, and then gives a quite full report of tests of the boiler and engine for the 1907 car, referring also incidentally to some tests made at Sibley College, Cornell University, to determine the specific heat of superheated steam, and finally a test made in 1903, by Prof. C. H. Benjamin, of the White system of that time, in which the engine was of only 10 horse-power.

The motive-power plant of the White motor car is a remarkable example of the use of steam of very high pressure and having a very high degree of superheat, and it is just as remarkable in the economical results attained. The most unusual feature of the plant is the boiler, which has sometimes been classed as of the flash or semi-flash type, though Professor Carpenter considers the name "continuous-flow" or "single-tube boiler" as more accurately descriptive, since the steam is continuously generated by the flow of fluid through what is practically a single long tube. The devices by which the steam generator automatically regulates the supply of water and of fuel to the demand for steam made upon the boiler are described and illustrations and brief descriptions are also given of the engine, condenser, pumps, and the arrangement of the whole upon the chassis and car complete.

The Engine and Boiler Tested

The 1907 engine is a vertical cross-compound having cylinders 3 inches and 6 inches in diameter, and a stroke of 4½ inches and is rated at 30 horse-power. The engine of 1905 and 1906 had cylinders 3 inches and 5 inches by 3½ inches and was rated at 18 horse-power. The boiler of the 1907 car consists of 9 coils of drawn tubing with an actual internal diameter of 0.53 inch, actual external diameter 0.72 inch. The external diameter of the boiler was 22 inches and its hight 11 inches; heating surface 45.8 square feet; weight without fittings 150 pounds, and total weight of the boiler 275 pounds, which with the weight of the burner 40 pounds, and the weight of the engine complete 328 pounds, make the total weight of the power system as 643 pounds. Since the maximum brake horse-power shown in the test was about 45, the weight per delivered horse-power is therefore about 14.3 pounds.

High Pressure and Superheat

Because of the small size of the engine, the economy tests were based, not on indicated horse-power, but on brake horse-power, an Alden brake being used to absorb and measure the power. After the completion of the brake tests at a speed of 850 revolutions a test was made with indicators at a much lower speed in order to determine the relation of brake horse-power to indicated horse-power. During the brake tests the boiler pressure averaged 595 pounds per square inch; the pressure in the steam chest was subject to wide variations by throttling according to the load, its average being 303 pounds. The temperature of the steam near the boiler averaged 783 degrees Fahrenheit, and in the steam chest 757 degrees Fahrenheit, the steam having, therefore, been superheated 340 degrees upon entering the steam chest; and since the exhaust had a superheat of about 28 degrees, the steam remained in a superheated condition throughout. Professor Carpenter believes that the high superheat had a very beneficial effect upon the economy.

Specific Heat of Superheated Steam

The experiments covering the determination of the specific heat of superheated steam covered a range of pressures from 0 to 220 pounds gage, and a range of superheat for these pressures to about 400 degrees Fahrenheit. The results show a direct increase of the specific heat of superheated steam with increase in pressure; and also a decrease in the specific heat of superheated steam with increase in the degree of superheat for constant pressure. As there were no other data available for computing the heat at the high pressures and high degrees of superheat, it was decided to use in computing the amount of heat supplied to the engine an extension of the curves derived from these experiments; the result being to charge the engine on the average with about 35

B.t.u. per pound of steam more than by considering the specific heat of steam as constant and equal to 0.48.

THE INDICATOR TEST

The indicator tests indicate that the work lost in friction at about 460 revolutions per minute averages 1.45 horse-power. The engine has ball bearings throughout. The engine friction at 850 revolutions per minute was assumed to be 1.6 horse-power. Sample indicator diagrams are given, taken with the link in different positions, varying the cut-off in the high-pressure cylinder from 10 to 75 per cent.

THE FUEL AND THE BOILER PERFORMANCE

The fuel used in the test was gasolene supplied by the Standard Oil Company. Its specific gravity at 60 degrees Fahrenheit was 68.5 Baumé, equal to 0.705, water being 1. The chemical analysis showed 84.76 per cent. carbon and 15.24 per cent. hydrogen, from which the heating value per pound is by calculation 20,400 B.t.u. The calorimetric value is somewhat below this theoretical calculated value. The average steam pressure at the boiler was 595 pounds; average superheat at the boiler, 298 degrees; mean temperature of feed water, 78 degrees; and the average evaporation, 10.34 pounds of water for one pound of gasolene. Taking the specific heat of the steam at 0.69, calculation showed the heat absorbed by the steam for one pound of gasolene burned to be 14,486 B.t.u., corresponding to an equivalent evaporation from and at 212 degrees Fahrenheit of 14.9 pounds per pound of gasolene. If the heating value of the gasolene be taken at 20,400 B.t.u. per pound, the boiler efficiency would be 71.2 per cent.

PERFORMANCE OF THE ENGINE AND OF THE PLANT AS A WHOLE

The consumption of feed water at the highest load was 11.96 pounds per hour per brake horse-power; the evaporation under actual running conditions with the feed-water heater in operation was 11.5 pounds of water for 1 of gasolene, showing that 1.04 pounds of gasolene would be used under best conditions per developed horse-power. Considering the engine friction as 1.6 horse-power, the water per indicated horse-power per hour would be, as calculated under the best conditions, 11.54 pounds, and the gasolene per indicated horse-power per hour 1.004, or practically one pound of gasolene per indicated horse-power per hour. Taking the experimental calorimetric value of 18,482 B.t.u. per pound of gasolene as its heating value, we find a heat efficiency for the whole plant on the basis of total heat supplied, as compared with that converted into useful work on the brake, of 13.25 per cent., and as compared with the indicated power the efficiency is 13.35 per cent. Using the heating value of 20,400 B.t.u. per pound of gasolene, these efficiencies become respectively 12.1 and 12.45 per cent.

PERFORMANCE OF THE 1903 ENGINE

The 1903 engine tested by Professor Benjamin was a vertical cross compound, with cylinders 3 and 5 inches x 3½ inches; it was not provided with ball bearings. The maximum brake horse-power developed was 11.4. A consumption of water was shown varying from 12.6 to 19.9 pounds per brake horse-power per hour, and varying from 10.8 to 14 pounds per indicated horse-power per hour, which, as Professor Benjamin remarks, was a very remarkable showing for an engine of that size, considering that ordinary simple engines used from 25 to 35 pounds per indicated horse-power per hour, and that 12 pounds is considered good performance for triple-expansion condensing engines.

The paper was discussed by W. S. Johnson, who pointed out that the boiler did not differ essentially from other single-tube boilers, which have already been shown to give as good an evaporative efficiency. The economy obtained is remarkable and appears to be due to the use of the superheater.

THE SESSION OF WEDNESDAY EVENING, DECEMBER 5

This session was not down on the program, but on account of the trip to the Sandy Hook proving ground on Friday, it was necessary to dispose at another time of the papers scheduled for Friday morning, and, therefore, a beginning was made by the reading of the following paper:

A Plan to Provide for a Supply of Skilled Workmen

By M. W. Alexander

In this paper the author first refers to an earlier paper by Professor Higgins, which was read before the society seven years ago, and in which he pointed out the lack of competent mechanics and proposed a plan for supplying them. Since that time the development of American industries has gone on at a tremendous pace and their character has undergone significant changes, particularly in the direction of specialization. This specialization naturally tends to lessen the demand for all-round, skilled men, but still the enormous development of industries requires a greater aggregate of skilled mechanics than were formerly required; and, the old-fashioned apprenticeship system having practically disappeared, it is incumbent upon manufacturers to devise and put in force something in its place which will be adapted to present-day conditions. This the General Electric Company has aimed to do in its Lynn shops, and the author describes the very interesting shop school and apprentice system which has been in use in that establishment for some years. Boys having a grammar school education and who are at least 16 years of age are here given an opportunity to learn a trade. Care is exercised in selecting them and there is a further weeding-out process during a trial period of a month or two. Sufficient wages are paid the boys to make them self-supporting, even during the initiatory or trial period, compensation ranging from $4.50 per week for the trial period to $9.25 per week during the fourth and last year. There is also a $100 bonus which is paid at the termination of the course. It is expected and experience has so far indicated that leading men, such as assistant foremen, foremen, master mechanics and superintendents, will be recruited from the ranks of graduate apprentices. The author describes the ordinary apprenticeship arrangement, points out its shortcomings, and shows wherein the arrangement at Lynn is superior.

There is in the works a department known as the apprentice training room. It has about 10,000 square feet of floor space, with a tool equipment of 105 representative machines. About 125 boys may work in this department at a time, and they work under the direction of a manager of that department who is selected not only for his mechanical ability, but also for his proven ability to impart instruction to others, and for his natural interest in such work. The tool equipment is, generally speaking, not of the highest quality, some of it being second-hand and a part of it recovered from the scrap heap, the idea being that such machinery is good enough for green boys to be broken in on; and they also get practice in the repairing and maintenance of such tools, many of the machines having been thus improved and fitted with attachments which have made them highly useful. There are of course also some other machines of initially higher quality. All necessary small tools are provided and about forty vises. The boys spend the first year and a half to two and a half years in this department, after which they go into the shop, but are still under the partial supervision of the manager of the apprentice department, who looks after them in connection with the foreman of the department in which they work. The manager of the apprentice department is a skilled manufacturer, and it is his duty wherever possible to inaugurate with the apprentices labor-saving methods of manufacture and to make and use labor-saving devices which thereafter may be accepted by the other factory departments. It is stated that he can without difficulty develop the highest practicable cutting speeds, for instance; that the training room stands for the best and most efficient methods, and is not hampered in its development along these lines by an attitude which may be encountered in factory departments on the part of regular workmen. Apprentices who have had experience along certain lines of work are depended upon to instruct those who have not had such experience, so that an apprentice is alternately teacher and pupil. Supplementary to the shop there is a class room where for six hours a week during

ten months of the year, instruction is given the apprentices by a competent instructor. The school room is close to the work shop, so that its sessions are held during working hours and arrangements are such that about one-fifth of the apprentices are in the school room at one time. The boys are paid the same wages for the school hours as they receive while working at the bench or at the machine, and this is declared to be a profitable feature of the arrangement, because progress is so fast toward complete competence that the company in the long run gains by this expenditure in the development for itself of more efficient workmen. The teachers are selected from the staff of engineers, draftsmen and foremen in the employ of the company, and the teaching is pre-eminently concrete, that is, it is applied so far as possible to the work which is going on in the shop, so that the boys immediately perceive the connection between the practical work and the study courses. Mechanical drafting is taught, and the boys are instructed in the design of tools, jigs, fixtures, etc., the problem of such design being often given to a number of the boys at the same time in order to develop individuality. Up to the present time 462 boys have been admitted to the trial service, 293 of whom have been indentured. Of the latter, 37 have terminated their contract on account of sickness, removal of the family from town, or other good reasons; 35 have broken their contract by seeking other employment during their apprenticeship, and 21 have been discharged for good reasons. Of the remainder, 29 have graduated; 171 are stili in the apprenticeship course, and 37 are serving their trial period. Of the graduates, 24 or all but five are still in the employment of the General Electric Company at Lynn, and the author states that most of those who have sought other employment will sooner or later return to their alma mater. The author believes that the success of the plan followed at Lynn is not peculiar to the conditions which exist there, but that it can be applied in a more or less modified form to any manufacturing concern of a suitable size.

He discusses also the possibility of making use of this apprentice instruction room for the instruction of those who may have lacked opportunities for learning the trade earlier in life, and who may wish to become experts in the handling of certain machines, or to learn the entire trade, and who are willing to work in this department outside of regular shop hours under the instruction of men paid for the service, preferably those who are in charge of the department. It is believed that the work that might be made in this way which would be usable would defray at least the expense of heat, light, power, wear and tear of machinery, etc.

Mr. Hutton read a contributed discussion by M. D. Higgins, who spoke of the great importance of a supply of skilled men, and the tendency of educational institutions to turn out engineering graduates who are more and more of the professional engineer and less of the skilled mechanic, and of the dependence, nevertheless, of the mechanical engineer upon the skill of the machinist. In speaking of the mechanical training of young men he referred to the industrial importance of what he called the "second stratum"—just below the stratum from which professional engineers are made. These are the boys who ought to learn trades. There is a great necessity to do something to meet the present dearth of skilled workmen, and the work of Mr. Alexander at Lynn is a step in this direction. Industrial education consists of two parts—skill and schooling, both of which are of equal importance. He advocates the half-time school system and considers that it is the place of the public school to fit boys for following a trade, the machinist's trade especially being by far the broadest of the mechanical trades. The difference between the machinist and the mechanical engineer is a difference of degree, not of kind. He spoke of the great possibilities of making all-around skilled workmen in a short time, and the possibility of producing commercial shop products by apprentices under good conditions. He thinks that the skill of the workman should not be confined to some one particular shop; it is possible to secure in the four-year course considerable mental discipline besides making a good workman. He thinks it a great mistake to train large numbers of men from the *top down*. There should be equal portions of schoolbook discipline and shop experience. Mechanical skill is something to be proud of, not to be ashamed of. He referred to the tendency shown in some quarters to disguise the shop training and to use such names as "machine laboratory," "molding laboratory," etc., in place of machine shop, foundry, etc. Knowledge and skill must be combined, but the greatest of these is skill. Almost all effort has been directed to obtaining more knowledge, but almost nothing done toward increasing skill.

Prof. C. R. Richards, of New York, said that one of the advantages of the Lynn school was the concentration of attention upon the instruction and separation of it from the commercial practice of the shop. He had examined some thirty apprenticeship systems in various establishments, and found that the best of these systems placed the apprentice under the care of a foreman who is responsible for his instruction. The inherent weakness of any scheme of training workmen in the shops is that the shop is established for production and not for instruction, so that a certain economic loss is entailed by attempts at carrying on instruction.

A discussion was presented by F. W. Taylor, in which it was stated that the apprentice should be encouraged to do more work for larger pay rather than less work for the same pay. There are some advantages in Mr. Alexander's plan of having the workmen taught by themselves, but it has the serious disadvantage that they do not have contact with the skilled workmen nor have the example of the latter before them. He made reference to the practice of having specialists or "functional" foremen, each having a responsibility one-eighth of that of the usual foreman, a plan which he thinks leads to remarkably rapid learning on the part of the workmen and apprentices. He believes that the Germans are in a fair way to outstrip us in the training of their artisans in the rudiments and principles of their trades. His hope was that the trades unions would have for their chief thought the educating and improving their members rather than the devising of means of forcing their employers to make concessions to them.

H. K. Hathaway believed that the General Electric Company's shop at Lynn was one way of overcoming the difficulty of obtaining skilled mechanics, and that the paying of wages 50 per cent. higher than ordinarily paid is a good feature, and he thought that better results would be obtained if the wages were to be fixed at say $8 a week at the start and made to increase by easy stages up to $12 a week. He considered that the building of trade schools was a far better way to get rid of burdensome millions than the building of libraries. He considered that the school described was at a disadvantage in depending so much upon the boys for leadership and in not having enough instructors in proportion to the number of boys. He cited an establishment where the Taylor system of management was in use, where they had the gang boss, speed boss, instructor, shop disciplinarian, etc., with the result that the company was not inconvenienced by a dearth of skilled workmen. In this shop 100 per cent. more work is turned out than was done before the system was employed. He mentioned examples of men who were greatly improved in their ability as machinists during their stay in the shop. Under the old system the apprentice got his experience and training as part payment. Under the new system more experienced men are attracted and are paid more because they are at the start able to earn more, and they are nevertheless able to add to their training while being useful men to the company.

Mr. Williston made some remarks upon certain points in Mr. Alexander's paper, and referred to a manufacturer in Cincinnati who had been complaining of the difficulty of securing mechanics, and upon being asked by his listener what steps were being taken to provide mechanics for the future, answered, "None," whereupon the listener retorted "You are in trouble, and I am glad of it." He said

that the idea of cultivating ambition instead of stifling it is the real vital point in Mr. Alexander's paper; at Lynn they give the boys the very best that the shops can afford; they have the best of foremen, the best class of work, for instance the making of jigs, special tools and fixtures, the rebuilding of old machines to improve their accuracy, tool-making, etc. The jobs are given to the boys to cultivate their reasoning power and stimulate their ambition. It is unnecessary to compare influences of this sort with the influences which surrounded the old type of apprentice.

L. D. Burlingame, of Providence, R. I., stated that the plan described must be modified when adapted to other works; at the Brown & Sharpe works they find it best to have the apprentices mix in with the other workmen in the various shops. He recommended that the manufacturers in this country take up the development of a modern apprentice shop system.

Mr. Porter said that we all understand that the primal object of giving instruction and education of the industrial kind to our workmen is not for a philanthropic purpose; it is purely to strengthen the organization; we must, however, do more; we must make the organization permanent. Education itself does not make a permanent organization. We must do something to keep the employees with us. He illustrated this statement by some instances. In a works in Pittsburg there was a loss for years, due largely to the fact that the management was poor and the class of workmen was of an inferior type. Betterment conditions were introduced into the works, which became more attractive and a better class of employees was drawn there. This place was a subsidiary works of a larger concern where they had an apprenticeship system, and the cry soon arose, "You must not take our apprentices away from us," so it became necessary for them to go into the apprentice system on their own account. Another example was a works in a beautiful suburb of Philadelphia, to the presence of which the wealthy residents objected, and they would not have a trolley line come into the neighborhood, so that the workmen had to walk 1½ miles to the works from the trolley line. The good workmen didn't have to do this, and they wouldn't stay there; the result was that they did not have a first-rate class of mechanics. He visited this place the day after Easter, which is quite a holiday in Pennsylvania, and the manager told him that he thought he better shut the works down as there were not enough men there to do the work. There were 98 men in the organization at that time, and 36 per cent. were absent, while most of the others were not in a very good condition for work. The conditions have been improved, however, and they now have 197 men, and when he was there the day after Thanksgiving, he found only 6 per cent. absent. He gave other instances of similar character, and said that it is necessary not only to educate the men in the works, but the managers should be also educated, so as to know how to keep the men. He commended the Society for the Promotion of Engineering Education, which was launched at Cooper Union last week, and referred to the German principle of making the employees healthy and happy in their homes, and then giving them industrial education. It is necessary that we should realize, as Germany does, the value of ethics in treating them, and then we shall be able to succeed.

George Henderson, of New York City, referring to the matter of transportation for the employees to the works described the conditions around a large new shop which he noticed about a year ago, and where it was intended to employ 1500 to 2000 men, and they were compelled to walk from 1 to 1½ miles through a rough country, with the result that absences were numerous in bad weather. He wondered how Mr. Alexander managed to keep his men after educating them so finely, it being his experience that competitors are willing to pay a little more to get those men that they did not have the expense of educating, and he also wondered what the machinists' union had to say on the matter.

Mr. McGill spoke of a visit to the shop, where the foreman showed him around, and after he got rid of the foreman he examined for himself, and found the boys doing a very good class of work, running important machines and knowing what their speeds were for, etc. The solution of the great problem of providing skilled workmen is a modern apprenticeship system. The workmen to do good work must understand the principles of the work.

Prof. Gaetano Lanza, of Boston, said that in a large establishment having a thorough apprenticeship system, a man who is in charge should not only look after the schooling of the boys, but should look after their method of life, know where they are boarding, etc. He spoke of thoroughness, of trying to do only as much as could be done, and of accomplishing what was once started upon. He thinks that it is dangerous to graft any more things on the public school system in addition to what it has now, but he thinks the education which the boy must have could be stopped at a lower point, and then he could proceed with his education for his business, either commercial or trade.

Mr. Gates said that the manufacturers' associations are moving in the right direction. The National Founders' Association has established a school in Indianapolis for instruction in the molders' trade, and the subject of establishing a a school is under discussion in the Metal Trades Association. If such associations will take hold of the matter they will find within themselves the material to carry on such schemes. He spoke of one institution where each apprentice was obliged to move away from the shop at the end of his term. However, they usually came back later, and returned compound interest. He believed that Mr. Alexander's system could be carried a little farther, that there could be added to it a shorter term for more advanced boys in which higher wages were paid, and a still shorter term and still higher wages for technical graduates.

Mr. Huson wanted to know how many really efficient men were turned out in Mr. Alexander's school.

Professor Robbins thought that there should be a school where a small tuition was charged, as a preparation for the course in the trade.

Mr. Alexander, in closing, referring to the statement that the system followed at the school was faulty because the boys were not surrounded by grown-up men, said that the present type of man had bad qualities as well as good ones, and by the system followed the boys did not have a chance to imbibe the bad qualities until after two years' training. Answering Mr. Hathaway's criticism that the boys acting as teachers could not instruct the others sufficiently well, he said that it was not necessary to have a great force of teachers, for after the instructor had told a boy how to run a machine it was not necessary for him to stay with that boy for hours and hours afterward, but the subsequent supervision could be left to a boy who had already attained proficiency. Regarding Mr. Hathaway's advocation of the sectional foreman system, he said that Mr. Hathaway forgets the conflict between the aim of the apprentice and the aim of the foreman. The latter wants production and was liable to keep the boy on a particular job longer than was good for him.

Regarding the question of taking mature men and educating them, he asks, "Well, what should we do with the boys?" We should get hold of them when they are 15 or 16, or even 14, when they leave school. He agreed with Mr. Williston that the cultivation of ambition was a very important key-note.

John Knickerbacker, of Troy, N. Y., made a contribution to the discussion, in which he hoped that the generous example of the General Electric Company would be followed and that the society would do its utmost to help along the good work. He recommended that the portion of President Roosevelt's message on technical and industrial training be printed in the transactions of the society.

The next paper, which was read by title, was

Ventilation of the Boston Subway

By Howard A. Carson, Boston, Mass.

This paper is a description of the very efficient means employed to ventilate the Boston subway system, which has a total length of about 4⅓ miles and consists of the original subway and the East Boston tunnel under the harbor, which are intended for single electric cars of the surface type, and the Washington street tunnel, which is intended for electric trains. The system followed is to supply fresh air at the stations or tunnel portals, and to draw the air out by means of exhaust fans at intermediate points.

THE "ORIGINAL SUBWAY"

In the "original subway" underground ventilating chambers were constructed at the sides of the tunnel and communicating with the latter by means of circular openings, in which are located exhaust fans run by electric motors. The air drawn from the tunnel by fans is discharged by passages leading to the surface, sometimes through grated areas in the sidewalk, and sometimes through low shafts; for instance, one of the latter comes up in King's Chapel burying ground just alongside of a tomb, but is so designed as to be inconspicuous. In the last mentioned ventilating station the two fans are 7 feet in diameter and have a rated capacity of 24,000 cubic feet per minute at 220 revolutions per minute, changing the air in this section of tunnel about once in 10 minutes.

THE TUNNEL UNDER THE HARBOR

The same principle is followed in ventilating the East Boston tunnel, although, as a point midway between the inlets would be under the middle of the harbor, it was necessary to form a ventilating duct below the roof of the tunnel by means of a mortar and expanded-metal partition suspended from the roof, so as to carry the air back from the middle of the tunnel to the fan stations at the ends of the subaqueous portion. The duct has a cross-section of about 48 square feet. At the maximum speeds the two fans in each chamber will together exhaust 45,000 cubic feet of air per minute, 90,000 cubic feet for the two chambers, producing an air velocity in the tunnel of nearly 2½ feet per second, so as to change the air in the section of the tunnel under the harbor every 15 minutes.

THE WASHINGTON STREET TUNNEL

For the Washington street tunnel it is not practicable to discharge the air through grated areas in the sidewalks because of the dense crowds on the latter. It therefore becomes necessary to convey the air through ducts having a cross-sectional area of about 40 square feet, located in some cases below and in others above the tunnel, to the fan chambers; in each chamber will be located two fans, each with a capacity of 20,000 cubic feet or more per minute, giving an average velocity of air in the tunnel of upward of 1 foot per second, equivalent to changing the air in each section about three times every hour. With the exception of the fan station at Adams square, the fan chambers and exits for soiled air will be on what was formerly private ground.

THE VITIATION OF THE AIR

Mr. Carson gives a table showing the results of tests for carbon dioxide (CO_2) in samples of air taken from different points. The samples taken from the subway (all fans but one being idle) show from 6.53 to 9.45 parts of CO_2 in 10,000 volumes of air, while a sample taken on the street in the central part of the city showed from 4.5 to 5.9; a sample taken on a surface car containing 65 passengers, before it entered the subway, showed practically 25 parts of CO_2, and samples from four of the principal theaters in Boston showed from 16.16 to 48.7. It is very pertinently remarked, however, that the fitness of air in the subway for breathing can probably be better ascertained by means of the sensitive noses of persons used to fresh air than by the ordinary methods of chemists. Crowded, unventilated subways contain not only carbonic acid and other matter thrown off from human lungs, but have also, widely diffused through the air, fine dust from the ballast, fine particles of oil from the machinery, and finely ground particles of iron from the brake shoes; all of which are disagreeable and probably injurious to health. Mr. Carson also speaks of the rise of temperature which was noticeable during the summer of 1905 in the New York subway, resulting from the conversion of the large amount of electrical energy into heat.

COST OF VENTILATION

The cost of the Boston subway ventilation system is estimated at less than 1 per cent. of the cost of the subway, and the cost of operation is 1 per cent. or less of all costs of operation and interests; from which it appears that in passenger electric subways the means for complete and positive ventilation should be freely used. Attention is also called to the necessity for ventilating not only the subway but the cars in the subway; from the figures quoted it is evident how bad the air in an imperfectly ventilated car may be, even when the car is out on the street.

The members already had the two following discussions in print, so they were not read:

Contributed Discussion on Mr. Carson's Paper on Ventilation of the Boston Subway

By Chas. H. Churchill

Mr. Churchill pronounces the Boston subway as being at present the only electrical subway in the country that is efficiently ventilated by mechanical means, and as not inferior to the plants of a number of subways which he examined in England, France and Germany. He stated, however, that the scheme followed in the ventilation of the East Boston tunnel is inferior to that employed in the Mersey tunnel, Liverpool, which was constructed in 1886 and is now electrically operated, inasmuch as in the former the duct area is obtained at the expense of the tunnel area itself, whereas in the Mersey tunnel it is entirely independent and outside of the main tunnel, avoiding the reduction of the area for the passage of fresh air. He expressed regret that Mr. Carson's figures for the percentage of carbon dioxide were not taken when the ventilating plant was in full operation and hoped that these data would be furnished so that it may be compared with observations which he gave as to the condition of air in various mechanically ventilated subways in Europe. Mr. Carson mentioned, however, that disregarding the carbon dioxide, the elements of dust from ballast, oil from machinery, iron dust from brake shoes, and heat from the conversion of large amounts of electrical energy would alone make mechanical ventilation of subways necessary. It should also be remembered that the air in the cars would be much worse than the general subway air, and, therefore, the proportion of carbon dioxide in the latter should be kept down proportionately; about 30 cubic feet of fresh air per minute to each person in the subway should be furnished. He referred to the disagreeable odor in the subway tunnel of the City and South London Railway, which is not mechanically ventilated, and also to that in the New York subway, and is glad to note that means are being taken to mechanically ventilate the latter.

Printed Discussion of Paper by H. A. Carson on "Ventilation of the Boston Subway"

By L. H. Woodbridge

In this discussion some additional particulars are brought out regarding the selection of the method described by Mr. Carson, of ventilating this subway. Among other ventilating schemes proposed for the original subway was one requiring an airway built close to and parallel with the subway and with passages connecting with it, the air to be supplied to the airway by a blower placed midway between stations; the airway extending from this midway point nearly to each of the stations. The various reasons why this method was not adopted, such as the cost of installation and operation, the inefficiency in the supply, etc., are dealt with in this discussion and the general advantages of the system finally selected are enlarged upon. Reference is made to the type of fan selected for the work, and a table is included compiled from results of tests made at the Massachusetts Institute of Technology on the performance of a variety of fans. Discussion of these fans is taken up and an explanation given of the reason-

ing which led to the choice of the type used.

Mr. Rice read a written discussion furnished by William Clifford, Jeannette, Penn., in which reference was made to the piston action of the trains in the tunnel, and the desirability of being able to increase the speed of the fans to compensate for it. He said that one fan installation could ventilate ten miles on the New York subway. An hour's application of the "hurricane" ventilation, in which all the power of the fans is at once directed to produce a current of say 60 miles per hour through a particular division of the tunnel, would remove the dangerous dust.

A contribution was read from Francis Fox, London, England, in which an analysis was made of the results of ventilation as given in Mr. Carson's paper, showing that whereas the amount of air required was 235,980 cubic feet per minute, and 292,000 cubic feet of fresh air were supplied, the ventilation was therefore ample. In London some of the tunnels are overventilated, so that there are objectionable drafts. The olfactory organs and the lungs are much more delicate tests as to the presence in the air of certain impurities than any chemical analysis, and he considered it important that the cars themselves should be thrown open to the air of a properly ventilated tunnel. He is glad that the system employed in the Mersey tunnel was applied to the Boston tunnel with such success.

Mr. Weinshank referred to the greater importance than the cost that the movement of the air is in a case like the Boston subway. He spoke of the advantage of a blower over an exhaust fan, because a greater amount of ventilation could be obtained from the former, if necessary, even at the expense of power. We use fans as blowers because we know that they will deliver the amount of air for which they are designed.

A written discussion was sent by Walter B. Snow, who was not present to read it; it stated that as long as the subway connects through large openings with the outer atmosphere, it is impossible under certain atmospheric conditions, for the fans of the capacity installed to properly control the flow of air, and in that case their effect would become merely local.

The next paper was

The Flow of Fluids in a Venturi Tube

By Edgar Park Coleman, Buffalo, N. Y.

This paper refers principally to the application of the Venturi tube to the measurement of the flow of steam, air and gases. After stating the general principles of the Venturi tube and deriving the formula for velocity of water flowing through it, as usually employed, the author derives equations for the flow of gas in a meter of this description, based upon the fundamental principles that the sum of the potential energy, the kinetic energy, and the energy otherwise lost up to the point in question is equal to a constant. The question in the case of gas is complicated by the intimate relation of temperature and density to change of pressure. The mathematical derivation involves calculus and several rather cumbersome algebraic expressions. In applying his formula practically he plots the locus of one of the factors for the particular Venturi tube in question and substitutes the proper observed values in order to obtain the quantity Q, which is the weight of gas in pounds per second. The velocity is obtained in a similar manner. Mr. Coleman states that for air, or gas of approximately the same density, at or near a pressure of one atmosphere, desirable values of the ratio of the absolute pressure in the throat to the absolute pressure in the up-stream section are between the limits of 0.95 and 0.995, corresponding to throat velocities of 100 to 300 feet per second. The throat velocity may be higher for a higher gas pressure; the limiting value of the lower velocity depends in general upon the least manometer reading which can be observed with sufficient accuracy, while the maximum allowable velocity will usually be determined by the allowable drop in pressure due to the meter. The formula may be applied to the case of an orifice through a thin plate by making the initial velocity equal to zero, or the initial area equal to infinity.

Tests with Steam and with Air

The author applied the Venturi tube to the measurement of blast-furnace gas when making some boiler tests in 1903, but did not then have means of checking its accuracy. Later, however, he was able to check the accuracy of a six-inch Venturi as applied to the measurement of the flow of steam. These tests showed that the ratio $\frac{Q}{W}$, in which Q is the number of pounds per second by the meter, and W the number of pounds per second by weight, were, in the case of the first test, 1.0006, and in the case of the second test 0.9916; it is important to note, however, that this steam was about 99.5 per cent. dry, and that in the case of wet steam the results, it is believed, will be erratic and unreliable. A report is also given of experiments in which the accuracy of the Venturi tube applied to the measurement of air was checked by means of Pitot tubes, with the result that $\frac{Q}{W}$ had a value of 0.9922 in the case of a ten-inch Venturi, and in the case of a six-inch one the value of $\frac{Q}{W}$ was 0.9975. Though this seems to be a satisfactory degree of accuracy, the tests described, especially those with steam, do not cover a sufficient range of conditions to be conclusive in every way. It is recommended that further experiments be made covering a more complete range of conditions for both gases and vapors.

A written discussion was furnished by Sanford A. Moss, West Lynn, Mass., who praised the use of the Venturi meter for measuring gases, having been using one for some time and having obtained practically the same results as those obtained by Mr. Coleman. There is only one point of doubt, the exact coefficient of discharge of the nozzle forming the initial portion of the Venturi meter; this coefficient varies from 0.94 to 0.99, but for commercial purposes it may be guessed at 0.96 or 0.97. For more accurate work it would be desirable to obtain more exact values. A set of mathematical formulas for use with the Venturi meter, equivalent to those of Mr. Coleman, but differing somewhat in form, were given in the AMERICAN MACHINIST, at pages 368 and 407. The formulas are there somewhat simplified by the fact that for the usual case the entrance velocity is practically negligible, and by use of an approximation which gives results almost identical to those of the formidable exact formulas.

In a written discussion Clemens Herschel said that Venturi's experiments published in 1797 were made with *expanding* ajutages only, not with compound tubes, such as he invented to be used as a water meter in 1887, and then named the "Venturi meter." He said that the tendency now was to call such a tube a Venturi, and that this serves him right for not having named the device the "Herschel meter." It was intended from the beginning to use it for all gases. He spoke of the intended use before the Boer war of the Venturi tube for measuring compressed air in South Africa; and considered it would be very desirable to test the meter by volumetric measurements, using gas-holders and thus do away with any uncertainty, and when once thus rated, the Venturi meter could thereafter replace the Pitot tube or any other velocity-meter method of measuring such gases.

Mr. Williston said that in some experiments which he made in St. Louis, the Venturi meter was checked by the Pitot tube to within less than 1 per cent. of the tests by orifices where the range of velocities was small enough so that the same meter could be used. But where the range was so wide that the same instrument could not be used, the results were not so satisfactory.

It being now pretty late, the session was adjourned.

The Session on Thursday Morning, Dec. 6

The meeting was called to order at 9:45 a.m. by President Taylor. The first matter taken up was the discussion of the paper on

Tests of a Plunger-Elevator Plant

By Arthur J. Herschmann, New York

This paper contains tabular reports of commercial tests on the hydraulic plunger-elevator plant of the Trinity building, New York City, while in regular operation. The tables are preceded by illustrations of the elevator apparatus and in-

dicator cards from the pumps which were used in the tests. The steam for the elevator pump was supplied by a Babcock & Wilcox 350-horse-power boiler, running at about half load. Boiler tests were made to determine the amount of coal used by the elevator system and the approximate water evaporation, and also tests of a 265-horse-power Babcock & Wilcox boiler which furnished the steam for boiler feeding and for purposes other than the elevator system.

DIMENSIONS, WEIGHTS, ETC.

The travel of the elevator from the basement to the twenty-first floor was 282 feet and from the sub-basement to the twenty-first floor was 294½ feet. An express elevator made the round trip, first to twenty-first floor, with 1617 pounds of load, stopping six times each way, in 2 minutes and 14 seconds. Doors were opened and shut, good stops insisted upon, and no advance orders given, the stops being ordered after the door was shut. The water pressure was from 165 to 185 pounds per square inch. The fuel used under the boilers was buckwheat coal No. 1 (11,650 B.t.u.) costing $3.40 per long ton. The weights of car were as follows: Frame and panels of freight elevator, 3500 pounds; of long-run passenger elevator, 2500 pounds; and of short-run passenger, 2300 pounds; the cab weights being 1125 pounds for each passenger cab, and the friction for each machine going up was 500 pounds and coming down 300 pounds. The weight of the plunger for the long-run passenger elevator, together with central rope, was 8460 pounds, and for the short-run passenger elevator the plunger and central rope weighed 4000 pounds. The diameter of the plunger was in all cases 6½ inches. The building is 298 feet high above the curb, covers a lot area of 10,920 feet and has a total floor space of 140,000 square feet.

AMOUNTS AND COST OF FUEL CONSUMPTION

With a Worthington compound duplex pump supplying the pressure, the evaporation per pound of coal was 6.29 pounds, the steam used per mile car travel 350.5 pounds, the amount of coal per car mile was 53 pounds and the cost of coal per car mile was 8.04 cents. Forty-five hundred passengers were carried in 9 hours, and the cost of coal per passenger lifted was 0.24 cent.

With a Laidlaw-Dunn-Gordon fly-wheel pump in use, the evaporation per pound of coal was 6.93. The steam used per mile car travel was 252.8 pounds, and the coal used per mile car travel was 34.4 pounds, being a saving of 35 per cent. over the duplex compound pump. The cost of coal per car mile was 5.22 cents. About 5000 passengers were carried in 9 hours, and the cost of coal per passenger lifted was 0.13 cent. In the figuring of costs, necessary losses such as leakage, slip and water consumed by pilots and motor valves are included.

William H. Bryan, of St. Louis, read a discussion in which he presented a record of what he considers the most efficient hydraulic-elevator plant in operation, consisting of 10 plunger machines in the May Company department store, St. Louis. The system was what is called a double-pressure system, but it actually has four different pressures in use, two working and two discharge, with two independent working-pressure tanks, and two independent discharge tanks.

By means of regulating and check valves the ascending car automatically selects its water from either of the two working-pressure tanks, the higher of which carries about 150 pounds pressure, and the lower about 120 pounds. Light loads are served by the lower of these two pressures, and heavy loads by the higher. In descending, the car can select the pressure tank into which it will deliver its water, the higher of the two tanks usually carrying about 45 pounds pressure, and the lower about 15. Lightly loaded cars discharge into the low- and heavily loaded into the high-pressure tank.

The efficiencies were found to be 4.05 kilowatt hours and 4.30 water h.p. hours, per car mile of travel, a result which he considers has never before been reached for heavily loaded cars. The apparatus is the invention of Thure Larssen, chief engineer of the Standard Plunger Elevator Company.

The next discussion was by E. S. Matthews, of New York City. From Mr. Herschmann's data, this elevator under 177 pounds pressure will raise 3218 pounds slowly, while the total lifting power of the water is 5873 pounds, or the elevator carries continually somewhat over 1¼ tons of dead weight up and down the shaft, giving a maximum live-load efficiency of 55 per cent. This must be considered a little disappointing as high-rise high-speed hydraulic elevators commonly show 70 per cent. He also considers the cost per car-mile travel as disappointing. He considers that the so called flying test had too much load in the car and would better have been called a "running test with a well loaded car." He gives formula for deducing the value of "*R*," the retardation or negative acceleration of the system under the given conditions. The tests showed that the actual stopping distances were about twice the distances that the shortest natural stop of the apparatus calls for. Both the overrunning distance and the time lost are about twice as great as would be permitted in practice. He considers the results of the running tests, opening and closing doors, etc., however, as very creditable to the elevator operator. Reference was made to the back-pressure choke-valve device, which is simply a water counterbalance. As the value of "*R*" decreases, the elevator approaches an absolutely uncontrollable state, and it may be interesting to see how the use of a water counterbalance increases the value of "*R*" and therefore renders the elevator more controllable; a mathematical analysis is therefore given for this purpose. The subject of elevator control is worthy of serious consideration, for it has more to do with the safety of passengers and the rendering of efficient service than any other problem connected with an elevator installation. He referred to an inaccurate drawing published in the paper and gave a discussion of the simplification of the valve construction. He also discussed methods of control, the relative chances of piping failure in the plunger elevator and cable breakage in the cable elevator. He considers the chances about equal. Reference was made to the wear of the casing, due to the bending of the plunger and rubbing of it against the casing; the renewal of the latter would be a pretty costly question with casings as deep as in the Trinity building. It is well to determine the solutions of some problems experimentally, and that of the comparative utility of plunger elevators for high rises is being rapidly advanced toward solution by that method.

During this session, on account of the large number of papers which had to be presented, the president had to repeatedly call attention to the necessity of not granting extensions of time.

Next a long discussion by Thomas E. Brown was referred to, but not read, on account of having previously been printed.

Mr. Brown questioned the advantage of the higher class of apparatus in view of its extra cost and the comparatively small saving realized, having reference particularly to the pumping machinery employed. He gives a discussion of various mechanical details of the elevator machinery, followed by a comparison of the Trinity building's elevators with those of the Hanover Bank building, Pine and Nassau streets, New York, of which tests were made in 1904. These latter elevators were high-rise geared hydraulic elevators and showed a mechanical efficiency of 87 per cent. against 91½ per cent. for the Trinity building. The excessive overbalance of the Trinity elevator, namely 2135 pounds, necessary to overcome the momentum of the heavy moving masses, as against 810 pounds of the Hanover Bank elevator, makes the ratio of live load to gross load lifted 61 per cent. and 82.6 per cent., respectively, bringing the final efficiency or ratio of live load to work done on plunger and piston for the Hanover elevator 72 per cent. and for the Trinity elevator 56 per cent. He makes an analysis of the action of the plunger elevator and makes certain recommendations as to the construction. A comparative table is given of the data and performance of the two types of elevators.

The secretary being temporarily absent President Taylor then read a contributed discussion by W. Y. Lewis, who considered that a better title for Mr. Herschmann's paper would have been "The in-

fluence of the power-plant design upon elevator operating costs." Comparing the results with the data given in Mr. Pratt's paper on the Park Row elevator tests, one might conclude that electric elevators are far superior to the hydraulic-plunger type. This, he believes, to be entirely contrary to general opinion, and actual fact. He commented unfavorably on the time a person has to wait for a car, because of the time interval between cars, so that the advantage of the high speed is to a considerable extent lost. He considers that it would be well if more attention were paid to the endless-chain system of elevators used in London, and in Europe generally.

Mr. Hutton then read a discussion by Fred. Meriam Wheeler, who did not consider that the pumps were sufficiently described. One was a direct-acting pump, running at 12 double strokes per minute on each side, the other a pump of the cross-compound triplex type, averaging 25.7 r.p.m., has one high-pressure steam cylinder, two low-pressure steam cylinders and three water cylinders. The latter had not only the advantage of more economical steam distribution, but its greater speed added to its economy. He also should have liked to see indicator cards from the water cylinders.

R. B. Bolton offered a few observations, saying that Mr. Matthews had dealt with the really vital questions. He considered it difficult to so proportion an elevator of travel of 283 feet, that they could make a stop within the distance that is commonly regarded as a safe distance where landings are located only 12½ feet apart. Within limits, there is no better type than the plunger type; he is still a firm believer in that type, but it must be constructed under proper proportions, and used under proper range, particularly with reference to the making of stops. He gave an analysis in figures, considering the weight of car, speed, unbalanced loads, etc., of the elevators in question, and stated that it would require 18½ feet to bring about a stop. It would be necessary to use a pretty large size plunger in order to get sufficient power to make the stops as required and that being the case the economy of operation would disappear.

One important point which he brought out was that the comparison of elevator plants by car-mile travel is all wrong; this is the same question which confronted the railroads some years ago, and in such a case nowadays a car-mile run by an empty train would not be compared with the car-mile made by a loaded train and the same thing applies to elevators.

Mr. Herschmann in closing said that he considered the discussion was infinitely more valuable than the paper. He referred, however, to certain jealousy shown in some cases, which he considered to be out of place before the society.

The next paper was read by title. It was

Tests of a Rotary Pump

By W. B. Gregory

This paper describes a complete duty test of one of the large rice irrigation plants of Texas, the capacity of the plant being 291 cubic feet of water per second. The plant tested is the property of the Neches Canal Company, and was described at page 103, Volume 29, Part 1, of the American Machinist.

Four years ago a paper on the subject of rotary pumps was read before the society by John T. Wilkins, in which he stated that he had found the combined efficiency of engines and pumps of this character to be from 80 to 84 per cent. This statement was received with a good deal of incredulity by engineers, especially those whose ideas of pump efficiency had been obtained from centrifugal pumps. In this incredulity the author of the present paper joined and hence he lost no time in availing himself of an opportunity to test one of these pumping plants.

The paper gives several illustrations of the plant, some of which are the same as those published in our own article referred to above, and, of course, it describes the plant in detail and gives the methods used in conducting the tests. The figures for efficiency given by Mr. Wilkins were thoroughly substantiated, the average efficiency being 83.28 per cent., and the lowest 83.08 per cent. The paper also possesses interest as a test of a large steam engine burning fuel oil.

Mr. Hutton then read a written discussion of Prof. R. C. Carpenter, who considered the high efficiency shown as being remarkable and liable to raise a doubt as to its correctness. It is possible that the Pitot tube is responsible. It is necessary to use this tube under favorable conditions in order to get accurate results, and it must be calibrated under the same conditions in which it is to be used. He considers that the discharge results and the efficiencies are too high.

Mr. Hutton then read a contribution to the discussion by A. M. Lockett, of New Orleans, who questioned the adaptation of the pump described to the practical working conditions in the Southern rice fields. He discusses his objections under the following heads, stated in the form of questions: First, on the basis of 83 per cent. efficiency for the rotary, and 70 per cent. for the centrifugal, will the additional first cost be justified as a commercial investment? Second, can these pumps be depended upon to deliver their rated capacities without the danger of breakage? Third, can these pumps in emergencies due to breakdown of other units be safely forced above their rated capacity, as can be done with the centrifugal pump? Fourth, is this pump liable to breakage by reason of foreign substances entering through the suction pipe?

The following paper was then read by title:

Improved Transmission Dynamometer

By W. F. Durand, Stanford University, California

This is a brief paper describing a transmission dynamometer developed by the author with the following aims: To reduce internal friction to a minimum; to eliminate belt slip or creep under heavy loads; to provide an apparatus of maximum capacity for given weight of material and therefore of maximum degree of portability; to provide for the measurement of turning moments either by spring balance, by beam-scale weighing or by hydraulic step and pressure gage. The dynamometer shown is practically a modification of the Tatham six-wheel form, in which the two side lower wheels are eliminated, and in place of pulleys, sprocket wheels are substituted and the belt is replaced by a chain. The mathematical expression for computing the work transmitted is derived, but it is recommended that such a machine be calibrated by the use of a friction brake mounted on the delivery shaft; in the case of the dynamometer described, both measurement and computation, and experimental calibration were employed, the difference of the results being an indication of the amount of power absorbed by the friction of the apparatus, which was shown to be slight. The machine illustrated was 30 inches high over all and had a base 12x30 inches, chain 3/10 of an inch wide. Its capacity was intended to run up to 5 or 6 horse-power, although it was successfully used to about 12 horse-power, which, however, imposed excessive wear upon the parts. No trouble was experienced in running the dynamometer up to 800 or 900 revolutions per minute. A larger machine of the same type is under construction, in which 12-inch automobile sprocket wheels are to be used and with which it is expected to realize a capacity of about 50 horse-power.

A written discussion by Prof. J. J. Flather, of Minneapolis, Minn., was read by Mr. Rice. Professor Flather speaks very favorably of the machine and considers it a great improvement on the ordinary belt-transmission dynamometer, but he prefers roller bearings to ball bearings, except perhaps for light loads and high speeds.

A short discussion by Professor Carpenter was read, in which he refers to a previous dynamometer on the same general principles which had been used at Sibley College for determining the efficiency and friction of bicycles, while making an investigation of the power losses in these machines.

The regular program for Thursday morning's session was then taken up, the first paper being

Saw-tooth Skylight in Factory Roof Construction

By Fred S. Hinds

This paper relates how the English or true form of saw-tooth roof was Ameri

canized by the author to meet the conditions of our rigorous and changing climate, and illustrates various buildings having this modified or semi-saw-tooth flat-roof design. In 1885, while considering a design for a factory roof, the author found that an English type of saw-tooth roof nearby was giving trouble from leaks, and so laid out his roof with considerable flat space between the saw teeth, the flats being covered with the usual gravel roofing and the slant of the roof carrying the water to the gutters at the ends of the skylights. In later designs he reduced the width of the flat-roof space between the skylights, this now ranging, according to circumstances, from 24 to 48 inches. Detail sketches of this form of roof are included in the paper and materials of construction, ventilation, etc., are also considered.

Professor Sweet states that at the time the weaving-shed roof of the Straight Line Engine Company in Syracuse was built, in 1889, he supposed that it was the first application in this country of this form of roof to machine-shop use. The drainage was by means of cast-iron gutters discharging into a continuous conductor inside, so there was no trouble with freezing. Their 17 years of experience with the construction has been so satisfactory that the same system has been adopted for the Artisan School. The spans are 32 feet, trusses 8 feet apart, and the glass 6 feet high. He considers the spacing better than the practice sometimes advocated of placing the trusses 6 feet to 20 feet apart, with purlins. The lower chord of the truss is very convenient for supporting the line shaft and counters, and in this respect he considers concrete inferior.

G. R. Henderson said in this discussion reference is made to what the author of the original paper states is the proper angle of saw-tooth skylights. Mr. Henderson states that while this angle is undoubtedly correct from a theoretical point of view, yet from practical considerations in connection with the structure of a building it is sometimes desirable to place these windows vertically. Line illustrations are included of a shop designed for the Missouri, Kansas & Texas Railway with saw-tooth skylights so arranged. The building was designed to stand the heavy winds of the western prairies and it was found that the arrangement of the trusses, etc., worked out much better with skylights having vertical windows than if they had been inclined.

PRINTED DISCUSSION BY AUTHOR

The author includes in this discussion an illustration of a two-story building with saw-tooth skylights, which type of construction he stated is particularly suitable for factories where land is too valuable for manufacturers to consider the erection of single-story buildings.

Samuel M. Green thought the author had not brought out in sufficient relief to be used by those attacking the problem for the first time, the troubles pertaining to the saw-tooth roof and he presented some of these difficulties, which he called faults in Mr. Hinds' design. Mr. Green's experience had been with roofs used in the textile industries, in which the requirements are somewhat different with respect to lighting, and especially with respect to the absolute prevention of leaking, from those found in machine shops and metal-working establishments generally. Leaks are caused by severe outside conditions, and inside condensation by low outside temperatures. Snow and ice cause water to back up in the gutters, and this water will find imperfections that otherwise would not cause trouble. Recently the speaker had designed a weave shed for 900 looms, for a concern which had buildings already in use with saw-tooth roofs, and where the benefit of this experience could be made use of. The first roof had been made in accordance with English designs and had given considerable trouble, due mainly probably to the difference in climatic conditions. It had been found in our northern climates that the sharp gutter had been impossible, and that a flat gutter roofed in the regular manner had appeared to be necessary. It is a mistake, he declared, to try to carry all the water to the end of the skylight or gutters, but it is better to put in downtakes at frequent intervals which would carry the water down through the building. He had found a 60-degree angle of glass to be satisfactory for the north, and there was no trouble with direct sunlight, especially if factory ribbed glass were used, which he recommended. He believed that the angle formed at the ridge of the roof should be 90 degrees or more, so that light will not be thrown against the inside of the roof. Double glazing should be used on account of its non-conducting qualities, though a serious objection to it is the difficulty of repairing it. He spoke of the difficulties attending the use of metal bar skylights for this work, these difficulties arising from the metal being a good conductor of heat, and also in some cases from its extreme expansion and contraction in changes of temperature. He summarized his practice as follows: Careful gutter design and construction to prevent leaks; no metallic connection between inside and outside air, therefore no uncontrolled condensation; careful provision to remove the water of condensation on the glass; no uncontrolled openings between the inside and outside which let in cold air; minimum obstruction of light; the use of factory ribbed glass which diffuses the light so that what light obstruction there is becomes unnoticeable. Referring to Professor Sweet's discussion of this subject, the speaker doubted if the design used in the Straight Line shops would be at all satisfactory for textile work on account of the condensation on the cast-iron gutters.

L. H. Kunhardt, in discussing the paper, said that his position was simply one of indorsement of the type. He gave some figures representing the construction of saw-tooth roofs in the United States, there being, according to his statement, now in use 2044 such roofs, insured in the companies with which the speaker was connected; there being over 500 of these roofs in Massachusetts, 277 in New York, 250 in Pennsylvania, 146 in New Jersey, and 137 in Rhode Island, these being the six States in which most of such roofs are used. He thought that it was a mistake to build the stories too low, 12 to 14 feet under the girders was, in his judgment, a minimum. The saw-tooth should face the north directly, or be no more than a few degrees to the east of north, and in securing this condition the saw-teeth may be made to run diagonally on the building if necessary. Ventilation should be by a fan system, as otherwise the middle of the wide buildings does not get sufficient fresh air. A common trouble was with leakage, but this could be overcome, he believed, by maintaining a flat graveled space of from 1 to not over 2 feet between the saw-teeth, and by insisting on good workmanship and material. Galvanized iron sash should be used, and ribbed glass is preferable, with the ribs vertical and on the inside of the glass. Sloping glass keeps cleaner under the same conditions than vertical glass.

Samuel M. Green believed that the angle of the glass as related to the direct rays of the sun, is not as important as might be supposed, and that the difficulty on this account becomes unnoticeable when factory ribbed glass is used.

George R. Henderson described a saw-tooth roof he had constructed, in which the glass sections were made vertical, and immediately behind them was a truss which had been introduced for the purpose of stiffening the roof and building against high-wind pressures. He had found this construction to be quite satisfactory.

W. B. Snow described the construction of a roof on one of the new buildings of the Sturtevant shops, near Boston. In this case there was a central bay with galleries at each side, and he presented an illustration of the shop. Though the illustration was unsatisfactory, yet it represented a shop construction and a result in lighting which was entirely satisfactory. Speaking of the use of saw-tooth roofs on foundries and the inquiry which had been made for the results of use of such roofs on foundries, he said that the foundry of the Brown & Sharpe Manufacturing Company had such a roof, which he believed was proving satisfactory. Mr. Kunhardt said that in his table, to which he referred, it was shown that about fifteen foundries having such roofs had been insured.

The next two papers were presented and discussed together.

Ferroinclave Roof Construction

By A. E. Brown

Our readers will recall the remarkable destruction by fire of the supposed fire-proof buildings of the Brown Hoisting Machinery Company, of Cleveland in 1900. These buildings were of brick with steel-frame construction, the only wood about them being in the floor and roof. The buildings were considered by the insurance companies one of the best of manufacturing risks and their wholly unexpected destruction by fire was the reason for the advancement of insurance rates on buildings of this character throughout the country.

As a result of the fire, the company decided that its new buildings should be in reality thoroughly fire proof, and owing to the weight of existing fire-proof roof constructions with the increased cost due to the necessity for making the buildings strong enough to carry them, the company was compelled to devise a roof construction of its own, which construction forms the subject of this paper. The roof construction is a slab of concrete reinforced with a corrugated sheet of steel and has been subjected to extended tests for strength, the results of these tests being given in the paper, which also includes several illustrations of the methods of applying the material both for roofs and for siding.

A written discussion of the paper was contributed by E. M. Hunting, who began his discussion with a statement of the requirements of a suitable roof for factory buildings. He criticized the Ferroinclave as not being a truly reinforced construction because of the metal section lying close to the neutral axis. He also objected that there is not sufficient key between the plaster and the metal, and he did not believe the construction would resist a severe fire and water test. He then described and illustrated his application of "Herringbone truss lath" to light fire-proof roof construction.

Saw-Tooth Roofs for Factories

By Knight C. Richmond

This paper states the advantages of this type of roof for textile mills, various classes of machine shops and other establishments. Where large floor areas are to be lighted, where the occupancy is such as to require only comparatively low head room and where it is desirable to avoid direct sunlight while still obtaining an abundance of almost perfectly diffused light there seems to be use for such roofs. The general arrangement of the saw-tooth lights, the angle of sash, methods of framing, and materials for roof covering are some of the matters considered. Also such points as the draining of roofs and the heating and ventilation of shops are discussed along with various other things pertaining to the subject. The illustrations include line engravings of wood-framed saw-tooth constructions for spans of from 12 to 30 feet.

In the discussion of these papers John R. Fordyce gave an interesting account of the saw-tooth roof used over the cotton-storage buildings used in the South, where the conditions were somewhat peculiar. As the buildings are used for only a short portion of the year, their construction must be cheap. They are not high because it does not pay to pile the bales of cotton high. They are protected from fire by automatic sprinklers, which are placed just over the bales. Little or no snow has to be dealt with, and vertical windows are used because simpler and cheaper. Instead of opening toward the north, these open toward the south because the rays of the sun are needed in drying the cotton, and in warming up the negroes.

A member in discussing Mr. Brown's paper wondered if he had ever examined a section of the Ferroinclave roofing after it had been in use for some time. He spoke of a case where such a roof had been in use for several years, and where by the falling of a heavy weight it had been ruptured, and the concrete had been found in good condition, but the cheap steel was represented only by a streak of rust.

Mr. Richmond, in his closure, emphasized the necessity of inclined lights rather than vertical ones, if the best lighting is to be secured.

At this point Professor Jacobus presented a preliminary report from the Committee on Refrigeration, in which he set forth some of the work so far done and conclusions arrived at and asked that the members send to the committee whatever further suggestions they may have to make in order that the work of the committee may be completed and presented in final shape at as early a date as possible.

Our Present Weights and Measures and the Metric System

By Henry R. Towne

This paper is an argument in favor of the enactment of a bill previously introduced in Congress by request of the author of the paper, which bill is designed to provide for the appointment of a technical commission, which shall be given time and authority for a full and complete investigation of the best course to pursue with regard to our weights and measures, and to make a report upon its findings.

The author first calls attention to the fact that our present system of weights and measures has been established by usage and by legislation of the States and that by it we have what other nations have sought to obtain by the adoption of the metric system; that is, uniformity of weights and measures for our home trade, and a system which corresponds with that which is used by a very large share of our foreign customers. He calls attention to the fact that France, Germany, England and other countries have all resorted to the plan of having a report, either from established scientific bodies, or from special technical commissions appointed to investigate this matter, and whose reports have been used as a basis for proposed or enacted legislation. In view of what the author calls the persistent agitation for the compulsory use of the metric system, the questions now up for settlement are: a, the retention of our present system unchanged; b, the retention of our present system modified and improved in its details; c, the adoption of the metric system. The author himself makes no secret of the fact that he favors the alternative b; that is, Mr. Towne does not believe that the gain by the adoption of the metric system will be sufficient to repay us for what he believes would be the expense and trouble of adopting it, but he does believe that our present system of weights and measures should be modified and improved to eliminate from them certain discordant and anomalous features. He refers to the duodecimal system and other alternatives, concludes that the decimal system is too well established to make it probable that it ever will be abandoned; but claims that the ideal system should be such that the masses of the people may follow their natural inclination to make binary divisions, while at the same time decimal divisions may be made by scientists, accountants, and those who have abstruse calculations to make.

Referring to the differences which now exist between the British gallon and our own, and to various other objectionable features of the present system, the author expresses the belief that with the slight change thus implied the British and American units of weight and of volume would be brought into perfect harmony and could be simplified into practically two tables or scales, one for weight and the other for volume. He believes, however, that these nor any other changes should be adopted until after exhaustive investigation of the effect of the proposed changes on all industries and interests concerned; and that, because the questions are serious, complex and highly technical they should be investigated by experts specially qualified for the work. The author states that the metric system as a whole has proven satisfactory for most uses, especially in abstract science, but has not proved entirely satisfactory in applied science, notably in the metal-working and textile industries. It being satisfactory to this degree is due, the author believes, not to the superiority of its unit, but to the fact that the interrelations of the metric units are systematic, logical and give it a marked advantage in constituting collectively a more scientific and logical series than exists in any other system. The author adopts, however, as his own the arguments previously made to the effect that a change of units in our

measures would involve the destruction of practically all the values now invested in special tools, fixtures, machinery, etc., used in the production of manufactured goods based upon the inch measurement, and on this account vigorously condemns any attempt looking toward the compulsory use of the system. To change the unit of length, he says, would be to substitute variety and confusion where now we have absolute uniformity throughout the Anglo-Saxon world. Assuming that the adoption of the metric system would mean changed dimensions of all articles now manufactured to the inch system, the author goes into the figures of the cost of doing this and states that one thousand millions of dollars would not cover the ultimate cost to the manufacturers of the United States. He gives figures of the growth of the exports of our manufactured articles to show that our persistence in the use of the English standard has not interfered with the development of such foreign trade, and expresses the belief that the change to the metric system could not materially affect our foreign business favorably.

The author says that if such a commission as he proposes is created its members should approach their work with open minds, unprejudiced and untrammeled, solicitous only of learning all the facts, of weighing all arguments, of hearing all interests, and of reaching conclusions which shall be sane, just, sound and permanently right. In support of this view he frankly admits that the longer he studies this question, and the more he grasps its importance and its relation to all the varied activities of our people, the more he realizes that no individual alone is competent to deal with it, and that a safe and enduring solution of it demands the combined labor and intelligence of many minds, each qualified by previous special training and experience in science, industry, agriculture and commerce, whose united judgment shall recognize, respect and conserve all of the varied interests concerned. In an appendix to the paper the author gives a copy of a bill for the establishment of such a technical commission as he advocates, which bill was introduced at the author's request by Mr. Lilley, of Pennsylvania, May 18, 1906, and was referred to the committee on coinage, weights and measures.

In consideration of the limited time for the presentation of this paper. Mr. Towne presented it by title only, assuming that it had been previously read by those especially interested in it.

J. Sellers Bancroft said that although in connection with the manufacture of injectors in the establishment of Wm. Sellers & Co., he had been making use of the metric system for 40 years and that he always thought of the dimensions of injectors in millimeters, yet he believed that the inch was a far better unit than the millimeter, and that nothing was to be gained by the substitution of metric for inch measurements. He, however, approved of Mr. Towne's suggestion for the appointment of a commission to investigate the matter.

Samuel S. Dale, who, though not a member of the society, was allowed to have his say and who presented a long written discussion, opposed the appointment of such a commission. He believed that the commission could not be properly constituted, asserted that the recent bills presented to the committee were compulsory, that they had been killed and that no commission was needed to bury them; he believed that the subterranean influences that would be at work in Washington would secure the appointment of incompetent men on the commission or that it would be composed of "dyed in the wool" scientists in favor of the metric system. He also expressed strong distrust of placing the matter of the appointment of such a commission in the hands of a President who had recently undertaken to reconstruct our language. The metric system he declared to be inferior to our own, and he also referred to the ignorance of editors regarding this subject, and to their teachings, to the effect that the metric system is the only scientific system.

Samuel Webber approved the appointment of the commission, but hoped it would continue our present standards, though he believed that some improvement could be made in further simplifications of them. He proposed some slight changes in our coinage to simplify exchange problems between this and other countries, and believed that this was a subject which might properly come before such a commission.

L. D. Burlingame, speaking both for himself and Mr. Viall, said that no matter how unfortunate it might be for an attempt to be made in the direction of the compulsory use of the metric system, he believed that the question should be judicially, calmly and scientifically considered. He approved of the appointment of the commission suggested by Mr. Towne and said that he or his establishment had urged the Bureau of Weights and Measures to take steps looking toward certain simplifications of our present standards. They had failed to receive this assistance, however, and he considered that the bureau had taken a partizan position with regard to the metric question.

Oberlin Smith discussed other numbers than the number 10 as a base of notation, called attention to the superiority of some others and suggested as an alternative to the decimal division of the inch the further binary division of it. The finest of these being now 1/128 of an inch, he thought we might go, if we choose, to the 1/4096 part of an inch.

A member whose name could not be caught, but who stated that he had had experience in the use of the English and the metric system side by side for 30 years in machine shops and mechanical-engineering work, had lived in Germany when the change was made to the metric system and had used both the old German system and the metric system there as well as the English system here, spoke strongly in favor of the metric system, expressing his belief that it was much superior both for the men in the shop and for those who had computations to make. Speaking only from his practical experience, he expressed his belief that the difficulties of adopting the metric system were very greatly exaggerated, he believed that the present standards of any value could be readily maintained, notwithstanding the use of the metric system and his depiction of the anomalies of the present system was evidently considered quite amusing by a considerable proportion of his audience, particularly when he referred to the peculiarities of the sizes of steel pipes and pipe threads.

Jesse M. Smith spoke of his experience in the use of the metric system abroad, where he had lived for some years and said he believed the metric system was more convenient than our English system. Referring to the assertions so freely made that the system is not really used in France to any great extent, he gave facts observed by himself controverting this, and related the results of inquiries he had made of people living in France, and who had told him that after the first year or two there had been no serious trouble with it.

H. H. Suplee, in a discussion which had been put in type, commended Mr. Towne's paper, and said that with it no further testimony seemed to be needed in favor of a technical commission to investigate the subject. He believed that it should be placed in the hands of a more highly-specialized body than was possible under present conditions. He then gave a full account of the legal steps which had been taken by the French Government in securing the adoption and use of the metric system.

Frederick A. Halsey strongly opposed the commission, saying that its only possible object could be to introduce changes in our weights and measures; to approve of the appointment of such a commission therefore, was to acknowledge the possibility and the need of a change, which he denied. He believed that a change in our system of notation might be a much greater improvement than any conceivable change in our weights and measures, but like our notation he considered our present system of weights and measures as a finality, incapable of being changed. The certainty of failure by the appointment of such a commission was, he considered, so obvious and its result would be so serious that he was absolutely opposed to any action which should countenance it. As to the minor changes

suggested by Mr. Towne as possible, he spoke of the various units used in the various industries and said, "Which of these shall the commission decide are to be made units to remain unchanged while the others are changed?" He believed that such a non-partizan, unprejudiced commission as Mr. Towne had in mind was an impossibility. Every man whose opinion is worth anything has his opinion formed already, and such a commission would resolve into a bi-partizan or tri-partizan body, in which agreement would be impossible. The history of the discussion, he said, had shown the entire inability of the scientific party to appreciate the manufacturers' position. Scientific men would enter such a commission with no object except to bring about the adoption of the metric system, and the deference paid to scientific men today would introduce serious danger of their success. He considered also that the salary proposed would be inadequate to secure the services of competent men. He declared that no nation has ever made serious progress toward the adoption of the metric system in trade and commerce, except by the force of compulsory law, and that no nation has ever discarded its old units by force of compulsory or any other law. There is, he declared, no reason why progress toward the adoption of other new units would be easier or more rapid than toward the adoption of the metric unit, and all the arguments against forcing the people to use metric units applied with equal strength against forcing them to use any new units such as might be proposed by such a commission. Referring to the recent circular letter of the French Minister of Commerce, Industry and Labor, which we have previously published an extract from in our columns, he quoted a similar statement from the Chamber of Commerce of Amiens, and inquired "What more is needed to complete the rout of the metric party?" He presented a number of letters from foreign consuls of the United States and others bearing upon the use of the metric system and other systems in the various countries from which the letters came and closed by a detailed statement of the manner in which the various arguments in favor of a trial of the metric system had been demolished, closing his discussion in the following way: "Had the metric party gone before the House Committee on Coinage, Weights and Measures at the start with the rags and tatters of a case that remains to them, the committee would not have been justified in listening to them for a single hour."

Rear-Admiral George W. Melville agreed with the paper in all that it says, except in the conclusion of its author that it would be desirable to appoint the commission referred to. He believed that Mr. Towne in his desire to be absolutely fair to everybody had conceded too much to those who favored the metric system. Before the recent hearings before the committee were held, he said he would have been in favor of such a commission, but since hearing the evidence presented before this committee, he could not believe that such a commission could be of use. Referring to the failure of the scientists to be convinced by the arguments that had been presented as to the alleged enormous cost and inconvenience of making the change, he severely condemned the scientists and said that it was shown conclusively that there are scientific bigots as well as theological ones.

He believed that such a commission could not come to any conclusion and that we should get from it a divided report which would leave us just where we are now. The Anglo-Saxon race has shown its competence to handle such problems as this intelligently, and he believed it would do it if the people were left alone to follow their own inclination. The commission he regarded as analogous to arbitration, and he did not believe that we could safely submit such a question to arbitration. If such a commission contained a majority of scientific bigots, it would render a report recommending the adoption of the metric system. This would not satisfy the manufacturers, and they would oppose any bill looking toward the compulsory adoption of the system. On the other hand, if the commission contained a majority of manufacturers, they would report against the compulsory change in existing weights and measures. This would not satisfy the scientists, who would continue their propaganda with the same mathematical zeal which has characterized them hitherto.

James Christie favored the appointment of such a commission and believed the plan would meet with the approval of the greater number of those who are interested in the subject of national standards. He believed the matter ought not to be left to the decision of the few radicals, and believed that it could be plainly seen that the question will be periodically agitated. The extended adoption of the metric measures in applied science, and the extension of the use of this system as a closely allied art, is, he believed, gradually bringing the subject closer to the masses of the community, and he instanced particularly the chemical industries in which the metric system is increasingly used. He believed that it was wise to go in a direction tending to obliterate all obstructions to the interchange of products between various countries of the world, and that it was good business policy to remove all such restraint as possible when other interests are not sacrificed.

William Kent expressed himself as not being sure that he was in favor of the appointment of the proposed commission; he believed it might be well to hold Mr. Towne's proposed bill until the next prometric bill is introduced in Congress and then present it to the committee as an alternative bill. He himself proposed some changes in our units, and particularly in the decimalization of the pound. He believed the present grain might be abolished, and that we might substitute therefor the one-ten-thousandth part of a pound, which would equal 0.7 of a grain.

He had found it necessary in some work involving fine weighing to use the metric system because it was a decimal system and because he did not have decimally divided avoirdupois weights. An ideal system in his judgment would be to have the pound divided by binary subdivisions down to one-eighth of an ounce and also decimally to one ten-thousandth of a pound. He advocated also the abandonment of all our gallons and the use of a new one of 216 cubic inches, which is 6 inches cubed. The bushel might also be abandoned and the cubic foot used instead. Our present standards of length, however, he believed would be retained and should be.

Fred J. Miller called attention to and read that part of the metric committee's report which had been agreed to and signed by all its members and which set forth the undesirability and impossibility of compulsory legislation on this subject.

Mr. Towne in closing said he did not believe in the superiority of the metric system and favored the retention of the present one. However, he did not believe that anyone was in a position to make absolute assertions respecting the matter. Conclusions based upon conditions as they existed 30 or more years ago would not do for today. It must be settled authoritatively and for all time. We have had much hearsay evidence and much partizan evidence; now we must have competent and complete evidence. The matter of its treatment in our schools must also be settled. He believed that Great Britain would meet us half way if such a commission as he proposed were to be appointed and that it might result in the harmonizing of the two systems in some points in which they are now discordant.

THURSDAY AFTERNOON EXCURSION

Thursday afternoon was spent in an excursion to the new Port Morris power station of the New York Central and Hudson River Railroad, by which the New York end of that road is soon to be operated. The plant consists of four 5000-kilowatt vertical Curtiss turbine units with provision for two more. Ample time was given for the inspection of the entire plant which, of course, represents the latest developments in steam and electrical engineering.

FRIDAY'S EXCURSION. MODERN DEFENSIVE ARTILLERY

The excursion on Friday to the Sandy Hook proving ground and Fort Hancock proved to be one of the most popular and interesting functions of the kind ever undertaken by the society. Nearly 600 members took the train on the Central Railroad of New Jersey at 9 a.m. for Sandy

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Hook, where they were met by the officers in charge, who conducted them through a most interesting program designed to exhibit the kind of engineering done in the installation and maintenance of modern coast defences.

Under the direction of Col. Chas. S. Smith, of the Ordnance Department, commanding, Brigadier-General Arthur Murray, Chief of Staff, and Brigadier-General William Crozier, Chief of Ordnance, and the officers commanding, an exhibition of the workings of modern defensive ordnance was given which was intensely interesting and instructive, especially to a body of engineers.

On the train going down, a paper by Lieutenant Mark L. Ireland, of the Ordnance Department and a junior member of the society, was distributed and Lieutenant Ireland was the leader and guide of one of the divisions of the visiting party.

The train first stopped near the famous 16-inch rifle which was completed at Watervliet some time ago and which, with the lathe and other tools for its construction, has been fully illustrated and described in our columns. It is the only gun of its kind that has been made and is the largest yet built in this country. Near it were to be seen several targets, two of these representing the armored sides of the "Iowa" and the "Tennessee" respectively. These were to be tested at various angles to the line of fire, designed to show the minimum angle at which shots would pierce the armor. The following events were then witnessed in rapid succession:

Two rounds from 6-inch rapid-fire gun mounted on barbette carriage, model of 1900, using cast-iron shell; gun maneuvered. Captain Westervelt in charge.

Five rounds from 15 pounder semi-automatic rapid-fire gun; gun maneuvered, under the direction of Captain Phillips.

Ten-inch rifle, mounted on disappearing carriage, model of 1901. Firings made under the direction of Lieutenant Dillard, with Tabor indicator and Sebert velocimeter attached.

Four and seven-tenths-inch seige gun, mounted on long recoil carriage, maneuvered. Firing made under the direction of Lieutenant Cross.

Three-inch field gun, three rounds of shrapnel, fired to explode over water at about 1000 yards range. Lieutenant Ireland in charge.

Ten rounds from the 1-pounder pom pom gun, Lieutenant Lund in charge.

Twelve-inch disappearing carriage, model of 1901, maneuvered electrically under the direction of Captain Ames.

Fifty rounds of 1-pounder sub-caliber ammunition fired from 12-inch rifles, battery Bloomfield, and 10-inch rifles, battery Granger.

The batteries along front as far as mining casemate were then inspected under the direction of the commanding officer, Fort Hancock.

Firings of one salvo of four mortars.

While at the mortar battery, the party witnessed the following firings from the ordnance proof battery:

One explosive shell fired from 12-inch B. L. mortar. Lieutenant Allen in charge.

Four rounds from 7-inch howitzer, two with black powder and two with high explosive, to explode in air down the beach, under the direction of Lieutenant Shinkle.

The party then proceeded to the gun lift where steam was gotten up and the platforms raised and lowered.

The range stations were explained under the direction of the commanding officer of Fort Hancock.

At the ordnance office the ballistic instruments were inspected under the direction of Captain Phillips.

The mine casemate was also inspected and the various officers very fully and in a very interesting manner explained every feature of the place that it was proper for them to explain.

General Crozier, in a neat speech of welcome, said that a very large share of what was to be seen there was really the result of mechanical engineering, and there was also very much of mechanical engineering in the operation and maintenance of it all.

General Murray called attention to the very greatly increased efficiency of modern artillery that had resulted from the work of engineers, military and civil, and in speaking of this and also of the influence of sub-caliber practice he said that in percentage of hits with a given outlay for armament and within a given interval of time the efficiency of ordnance had been increased within the past few years by about 40 fold.

It is not often that civilians are privileged to see the firing of so many kinds of guns as was witnessed on this occasion, especially guns as large as 10-inch caliber, and though the day was bleak, with a strong north wind blowing which sometimes carried sand with it which seemed to cut the faces of the visitors like a knife, it was clear, the rough sea was beautiful, the columns of water and of spray thrown up by the striking shots impressive and magnificent and the handling of the guns very admirable, so that the occasion was very much enjoyed.

With the return of the party to New York ended one of the most successful meetings ever held by the society, and the most largely attended meeting. The registration was considerably over 1100, and far exceeded the expectations of the officers, so that the supply of numbered badges ran out as did also the tickets to the reception at Sherry's, which as usual was a very enjoyable affair.

The council held a meeting on the train going down, at which meeting Calvin W. Rice was formally elected secretary of the society.

PROF. FREDERICK REMSEN HUTTON, PRESIDENT OF THE A. S. M. E.

What may be considered the principal distinguishing feature of the recent annual meeting of the American Society of Mechanical Engineers is that it marked the termination of the twenty-three-year term of service of Professor Hutton as secretary of the society and his election to the office of president.

We have previously announced the fact of Professor Hutton's intention to retire from the secretaryship at this time and his reasons therefor—principal among these being the fact that the society's work has now become so considerable as to require all the time and energies of its secretary. These Professor Hutton could not give because of his professorship at Columbia University to which he felt he owed his first allegiance.

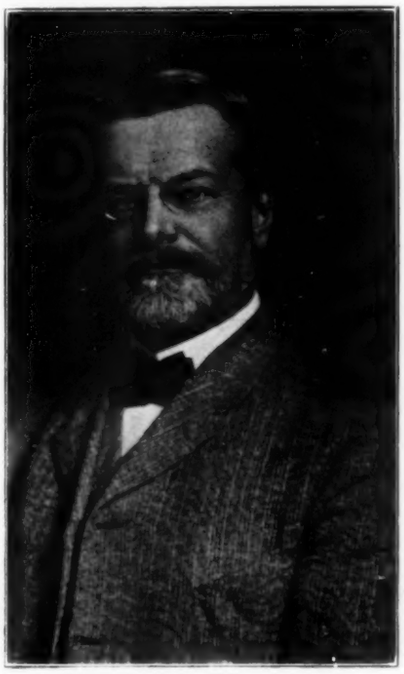
The new president was born in the city of New York May 28, 1853. After preparation in a private school in New York, he entered Columbia College, receiving the degree of A. B. in 1876. He then entered the School of Mines and took its degree in 1876. One year later he was appointed as instructor in mechanical engineering, as an associate of the late Prof. W. P. Trowbridge. This was the first recognition which Columbia gave to the important relations of mechanical engineering to other engineering courses. He entered the faculty as adjunct professor in 1881 and became full professor in 1890.

On the death of Professor Trowbridge in 1892 the Chair of Engineering which he had occupied was divided and professorships in civil engineering and electrical engineering were added to the already existing professorships of mining and mechanical engineering. Since that time to the present Professor Hutton has been the head of the mechanical engineering department.

BUILDING UP OF A GREAT LABORATORY

Perhaps his most significant achievement during these years of service has been the development of the great mechanical laboratories of the University, during the period from 1897 to 1900, just subsequent to the transfer of the institution from the downtown site to its present location on Morningside Hights. This equipment includes the Baldwin locomotive mounted upon its testing equipment, the triple-expansion Allis-Reynolds engine, which is a three-stage air compressor, and the hydraulic equipment of the Henry R. Worthington Laboratory. A conservative estimate of the value of this equipment as installed, is not far from $100,000.

It has been the professor's belief that to make experiments in illustration or confirmation of engineering formulas on engines or machines of small size, is to introduce an error not only of degree, but of kind, and that therefore the units should be of sufficient size to guard against this difficulty; and, furthermore, to make research into new fields sufficiently near to the actual conditions of practice so as not to prove actually misleading when their results are applied. The air compressor has been, with him, a favorite form of laboratory apparatus by reason of its illustrating to the student the complete cycle of generated mechanical energy, its storage in compressed air, and the liberation of that energy in a motor having exactly the same cycle as the original steam



PROF. FREDERICK R. HUTTON

cylinder. In no other educational institution are there any larger units than those which have been here gotten together.

COMPELLING THOUGHT

The professor is also an earnest exponent of such a method of conducting laboratory instruction as to compel the student to exercise his thinking faculties, not only in devising the experiments and connecting up the apparatus, but in the interpretation of the results. In his discussion of this subject he has referred to the more formal system of definite instruction to the students by the use of printed logs which can be used half automatically as failing to make men out of the raw material. The automatic or log method he has called "the cook-book system."

Columbia has honored his achievements within its walls and outside, by giving him first the honorary degree of Ph.D. and later, on the occasion of its 150th anniversary, the degree of Sc.D., which is the highest that it confers in the fields of science.

SECRETARY IN THE EARLY DAYS

In 1883 The American Society of Mechanical Engineers, which had then been in existence for three years, became in need of a new secretary and the choice of the council fell upon Professor Hutton. He began in March of that year to perform the duties of the office (and more) in an office at No. 17 Cortlandt street. The society seemed to feel at once the infusion of new energy and began a career of advancing prosperity. The work outgrew the modest first office and was then moved to the Stewart building from which again the growth of the library forced it to larger quarters at 67 Madison avenue. It was the secretary's energy and ambition which induced the conservative council of that day to give favorable consideration to the project of purchasing the house at No. 12 West Thirty-first street, New York, in 1890. The recent sale of that house at twice the purchase price of sixteen years ago, is a gratifying confirmation of the financial wisdom of the step which was then taken.

The secretary arranged the details of the trip of the society to England and France in 1889, which was the first undertaking of its sort and which appeared to be of such great benefit in giving international position and recognition to the society. Professor Hutton has been an active member of the Trustees and Building Committee appointed by the Society of Mechanical Engineers for the consideration of the problems raised in connection with the building of the engineering societies, the gift of Andrew Carnegie, and has been the secretary, both of the Building Committee and of the Trustees, which are the holding corporation for the societies. He has given much time and thought to the problems brought up in the planning of the building and in the consideration of much detail which could not be considered in the larger body.

He relinquishes the work of the secretaryship just as the society is leaving its house in Thirty-first street where it has been so long and which it has so entirely outgrown, and will be the first president under the new conditions attending its occupancy of the new building made available for its use by the munificence of Mr. Carnegie.

OTHER WORK

From the nature of his duties in Columbia University and in the society's office, with their complete absorption of his available time, it has been impossible for Professor Hutton to undertake any very considerable creative work in engineering practice or in the consulting field. His contributions to engineering have, therefore, been restricted to the work of

an expert before the courts and in patent cases and as a contributor to the scientific literature of the day. His three most important books have received considerable acceptance in the educational field in the United States and in England. They are: "The Mechanical Engineering of Power Plants," "Heat and Heat Engines" and "The Gas Engine." The "Power Plants" is used as a text-book in some of the technical institutions of Japan. He was also author of two of the important monographs of the Census of 1880, one covering machine tools and the other pumps and pumping engines.

He has contributed to the Transactions of the Mechanical Engineers, both over his own name and with unsigned contributions, memorial monographs, contributions to discussion and the like. He has been asked to act as associate editor in such work as the revised edition of Johnson, and is now engaged in revising, simplifying and bringing up to date the scientific and engineering titles in the "Century Dictionary." He has also been departmental editor in the *Engineering Magazine*, a contributor to other technical journals and has at various times lectured before scientific and popular audiences in New York and elsewhere.

An interesting pamphlet on Steam Traps, by W. H. Wakeman, is published by the Joseph Dixon Crucible Company, Jersey City, N. J., from whom copies can be obtained. The pamphlet contains 30 pages and numerous illustrations of the several varieties of traps, and a discussion of them by Mr. Wakeman, who is a well known writer on steam-engineering subjects.

NEW TOOLS AND MACHINE SHOP APPLIANCES

A HEATING MACHINE

Fig. 1 shows a general view of a machine which may be used for annealing, hardening, tempering or coloring metal pieces in quantities. The heat may be obtained from either oil or gas. If oil is used it may be atomized with either steam or air. Fig. 2 shows a section through the feed arrangement of the machine. In this instance balls are being handled.

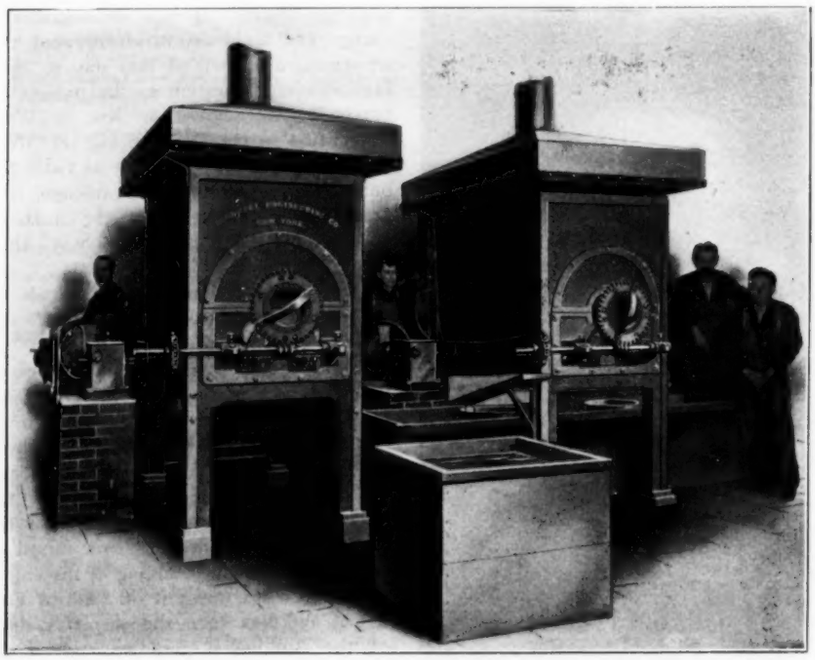


FIG. 1. A HEATING MACHINE

These are charged into the feed drum; they are then automatically carried through the furnace and discharged at the correct temperature into the cooling tank. As

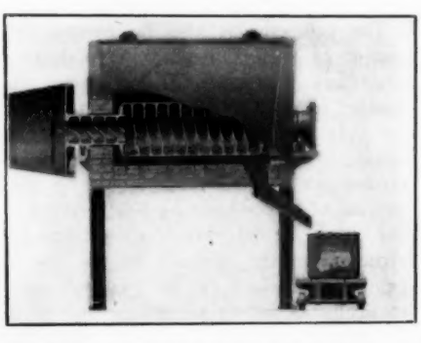


FIG. 2. SECTION THROUGH THE FEED ARRANGEMENT

it is not necessary for them to come in contact with air oxidation is entirely prevented.

The driving power required is about ½ horse-power; floor space necessary, 108x48 inches; hight, 80 inches; oil consumption, 2 to 2½ gallons per hour; gas consumption, 300 to 500 cubic feet per hour.

These machines are made by the Rockwell Engineering Company, 26 Cortlandt street, New York.

Obituary

H. J. Hendey, President of the Hendey Machine Company, Torrington, Conn., died at his home December 8, aged 61 years.

Geoge Henry Felt died December 4 at his home in New York City, 74 years old. He was an inventor, and before the Civil War invented a breech-loading cannon. During the war, when attached to the Signal Corps, he invented the Felt rocket, which was used in that arm of the service.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith Co., Columbia, Pa.

Cox Computers. 75 Broad St., New York.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Steel case-hardened by modern methods. Boston Gear Works, Norfolk Downs,, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

Novelty in tool or machine specialty wanted. Particulars required. Box 202, AMER. MACH.

Special machinery designed and built. Walter S. McKinney, M. E., 43 Broadway, Flushing, N. Y.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Estimates given on machine work, patterns and designing in all branches. Address Greenfield Steam Engine Works, Harrison, New Jersey.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Buyers of brass goods—Before placing orders see us for prices of castings and finished product. Good workmanship, prompt deliveries. S. J. Asbell Co., Paterson, N. J.

Boston manufacturers' agent wishes to represent established firm in this vicinity; will take on first-class line on commission basis. Address Box 367, AMER. MACHINIST.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Not using the whole of our modern factory plant, we should like to take up the building of any small high-grade machines, or parts of machines, in large or small quantities. United Sewing Machinery Company, Springfield, Mass.

Contract work — A large, well equipped foundry and machine shop in Ohio is open for

ontract work; moderately heavy work preferred, such as machine tools, engines, compressors, or any special machinery. Address Box 370, AMERICAN MACHINIST.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

We have a modern up-to-date manufacturing plant and, having recently more than doubled our capacity, are in a position to take contracts for the manufacture of special tools, small high-grade machinery, or parts of machines in large and small quantities; we can refer you to a very well known line of high-grade tools now on the market to demonstrate that we are able to do the highest grade of interchangeable work. Will be pleased to furnish estimates upon receipt of drawings and specifications. Box 363, AM. M.

Business Opportunities

Wanted—Toolmaker capable of getting up new tools, and willing to take stock in business. E. G. Smith Co., Columbia, Pa.

Wanted to contract with shop within 50 miles of New York City, equipped for making highest grade automobile chassis. Must have capacity for at least 100 cars per year and able to do highest grade interchangeable work cheaply. No body work. Box 210, AM. MACH.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Two second-hand cupolas in first-class condition; shells 72″—82″ in diameter and about 40 feet high. Box 333, AM. MACH.

For Sale—Gear cutter; light foot or power gear cutter with 24 cutters, suitable for model or clock maker. J. McLaughlin, 326 Market street, St. Louis, Mo.

For Sale—Owing to changes in plant, large lot cast-iron split pulleys for double belt, 24″ to 84″ diameter. Nathan Manufacturing Co., 416 East 106th street, New York.

For Sale—Foundry and machine shop in a thriving town, eastern Iowa; no competition within 40 miles; it's a snap; must be sold for about half its value. Write today to G. W. Eastwood, Monticello, Iowa.

For Sale—Machine shop with about 20,000 sq. ft. manufacturing floor space, equipped with almost new power plant, complete main line of shafting and pulleys, situated in Worcester, Mass., on corner lot of 18,569 sq. ft. of land next railroad. Box 417, AM. MACH.

For Sale—One 36″x36″x10′ heavy Fitchburg planer with three heads; this planer has been in use but a few months; is practically better than new, but is too heavy for our requirements. A purchaser can have immediate shipment. Lock Box E, Fishkill-on-Hudson, New York.

Foundry and machine shop for sale, with good will, in the northwestern part of Philadelphia; plant now running and is complete with core shop, engine, rattlers and cupola, with capacity for 5-ton heats; area of property 12,000 sq. ft.; streets on two sides; good local jobbing trade; owners consolidating plants elsewhere. Full particulars may be obtained by addressing Box 380, AM. MACH.

For Sale—Foundry and machine shop, electric, fully equipped; cost $108,000 to erect and equip; acquired upon debt; title good; centrally located; lies between two railroads; paved streets, electric lines, sewers, city water; solidly built of brick, fire-proof pattern storage, etc. A snap bargain. A portion of purchase price down, balance in deferred payments. Address The City Bank, Battle Creek, Michigan.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Inventor (33), now employed, wants to change; typewriter or similar work preferred. Box 339, AMERICAN MACHINIST.

ILLINOIS

Mechanical and structural draftsman, age 33, technically educated, five years' drafting and seven years' machine-shop experience, at present employed, would like to make a change. Box 413, AMERICAN MACHINIST.

Draftsman, engineer, graduate M. E., employed, age 30; some shop practice and nine years' experience designing special machinery, instruments, typewriters, tools and fixtures for interchangeable parts, etc.; able, inventive man; will accept position as chief draftsman, leading designer, assistant to superintendent, or the like; location immaterial. Box 393, AMERICAN MACHINIST.

Wanted—Position as superintendent by a clean-cut man tactful and ambitious; age 37; expert mechanic; 20 years' training in modern methods designing and inventing special machinery and tools, and dies and labor-saving mechanical devices; capable of analyzing the requirements of each department of your business and suit a system as near automatic as possible; four years' experience as superintendent and preliminary engineer of a large machinery-manufacturing company; indefatigable worker; reference gilt-edged; Chicago concern preferred. Box 399, AMERICAN MACHINIST.

IOWA

Mechanical engineer wants to get charge of a line of work with good people; $1600. Box 387, AMERICAN MACHINIST.

MASSACHUSETTS

American (32), 12 years' experience as toolmaker foreman and designer, wishes position as general foreman or assistant superintendent; technical, practical and reliable; best of references furnished. Box 406, AM. M.

MICHIGAN

Superintendent wishes to make a change; experienced in the commercial manufacturing of both small and medium machinery with the interchangeable system; a systematizer and cost reducer; have held the following positions: toolmaker, tool designer, foreman and master mechanic; willing to go anywhere; New England preferred. Address Box 403, AMERICAN MACHINIST.

MISSOURI

Manager or shop superintendent; 23 years' experience, technical education, good executive ability, strictly up-to-date on shop organization and management; guarantee reduction of costs. Box 416, AMER. MACH.

NEW JERSEY

Mechanical draftsman is now open for engagement. Box 401, AMER. MACHINIST.

NEW YORK

Mechanic with shop, technical, drafting room and executive experience desires position. Box 398, AMERICAN MACHINIST.

Experienced gasoline engine and automobile designer will be open for engagement after Jan. 1. Box 377, AMERICAN MACHINIST.

Mechanical engineer of proven ability, expert draftsman and machinist, wishes responsible position with progressive firm. Box 415, AMERICAN MACHINIST.

Designing draftsman wishes position where ability, experience and thorough knowledge of modern office and shop methods will be valued. Box 414, AMERICAN MACHINIST.

Graduated mechanical engineer desires position as chief draftsman for small contracting concern or machine works; best of references. Box 400, AMERICAN MACHINIST.

Wanted—By mechanical engineer, position as superintendent or manager of machine works; special ability in installing systematic methods of manufacture. Box 317, AM. M.

Position as foreman or assistant foreman in an up-to-date machine shop; 24 years' experience at general work; location, middle West. Address C. H., AMERICAN MACHINIST.

Position as works manager with company employing about 200 men; am desirous of associating with a company that wants to cut the cost of manufacture and increase their output; excellent executive ability, successful in the handling of men. Box 374, AM. MACH.

PENNSYLVANIA

Machine-shop foreman desires change; good experiences and references. Box 410, AM. M.

As draftsman in eastern Canada—Englishman, eight years' drawing, office and shop experience, two years United States, Corliss engines and millwrighting. Box 412, AM. M.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted—First-class toolmakers and lathe hands; those accustomed to punch and die work preferred. The Northern Electric & Mfg. Co., Ltd., corner Notre Dame and Guy streets, Montreal, Quebec.

CONNECTICUT

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

Wanted — Tool makers, die sinkers, drop forgers and men familiar with grinding machines. Apply to D. P. Beckwith, Pope Manufacturing Company, Hartford, Conn.

Wanted — Four first-class draftsmen for general work; must be rapid and accurate; in answering give full particulars as to age, experience in detail and salary required; positions will be permanent for right men. Address Box 389, AMERICAN MACHINIST.

INDIANA

Wanted—Foreman in bowl-balancing department, correspond with AMERICAN MACHINIST, Box 409.

Increasing force—Wanted, ten lathe men; also three toolmakers; good wages; open shop; steady employment. Western Motor Co., Logansport, Ind.

IOWA

Wanted—High-class mechanic to take charge of tool department of about 15 men in a duplicate-part factory in a small Western city; state experience and length of service with previous employer. Box 411, AMER. MACH.

MASSACHUSETTS

Wanted—Metal patternmaker competent to take charge of metal pattern work; state age, experience and salary expected. Address Box 350, AMERICAN MACHINIST.

MICHIGAN

Wanted—Sales manager for moderate sized, growing, prosperous machine-tool plant; good correspondent; state positions occupied, experience, age and salary wanted. Address, in handwriting, "Sales," AMERICAN MACHINIST.

MISSOURI

Wanted—Machinists, electricians, engineers and firemen, do you want to "get wise?" Send for 52-page pamphlet containing questions asked by different Examining Boards; sent free. Geo. A. Zeller Book Co., 53 South 4th street, St. Louis, Mo.

NEW JERSEY

Wanted — Ten good machinists and six good millwrights. Apply to New Jersey Engineering and Supply Co., Passaic, N. J.

Wanted—A mechanical draftsman on small tool and jig work; state age, experience, references and salary expected. Box 407, AM. M.

Wanted—Lathe, planer, vise and machine hands; good wages for first-class men. The Standard Motor Construction Co., 180 Whiton street, Jersey City, N. J.

Draftsmen—On general industrial plant extension, furnaces, mill buildings, pumping layouts, machinery repairs, etc.; state age, experience, initial salary and references. "General," AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

Floor foreman wanted—One familiar with screw and milling machine and lathe work; good handler of men; good wages for right man; location, Jersey City. Address Box 404, AMERICAN MACHINIST, stating experience and present occupation.

Mechanical draftsman for works in New Jersey; permanent position and opportunity for advancement; technical graduate with two or three years' experience preferred; applicants, to be considered, must state nationality, age, experience, references and salary expected. C. F. B., AMERICAN MACHINIST.

As we are continually adding to our departments, we have openings for men familiar

with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

Superintendent — Corporation requires the services of competent man accustomed to the latest and best machine-shop methods and practice, capable of organizing and handling a machinery plant in all its branches; preference given man able to design special and automatic machinery, tools, jigs and fixtures for the rapid and economical production of fine and medium heavy interchangeable work. Box 366, AMERICAN MACHINIST.

NEW YORK

Wanted — Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

At our new factory — Toolmakers experienced in fine and complicated work; steady employment and good wages. Jones Speedometer Co., New Rochelle, N. Y.

Draftsmen on jigs and fixtures for duplicating work; none but experienced men wanted; good pay for right men. Mergenthaler Linotype Co., 20-24 Ryerson St., Brooklyn, N. Y.

Wanted after Jan. 1, 1907, some competent millwrights; applicants must state wages expected and when they can start work. Address A. A. P. C. W., Alsen, Greene Co., N. Y.

Wanted — Tool-room foreman, capable of handling 25 men on accurate work; please state age, experience in full, wages expected and references. Address Box 384, AM. MACH.

Technical men everywhere in spare time. No goods to sell; no expense; professors, draftsmen and literary machinists thus far appointed; state experience. Box 334, AM. M.

Wanted—One good man in every machine shop to sell Gre-Solvent to his fellow-workers; five to twenty dollars weekly may be earned, according to size of shop. Write us, stating shop where employed. Utility Co., Room 100, 332 Broadway, New York.

Wanted — An experienced mechanic with good address who understands thoroughly turrets, automatic machines, etc., to represent a well known house with an established trade, calling upon the iron and steel plants in western Pennsylvania and Ohio; state experience, age and salary expected at start. Box 375, AMERICAN MACHINIST.

OHIO

Wanted — First-class designing draftsman familiar with automatic machinery and power punches; steady position to capable man. Box 388, AMERICAN MACHINIST.

Our growing business constantly requires additional machinists. We build lathes, planers, shapers, drilling machines; good opportunity for machinists. The American Tool Works Co., Cincinnati.

Wanted—A mechanical engineer and draftsman, preferably one who has had some shop experience, who is up-to-date in machine design and has the executive ability to handle the routine work of a small drawing room; please state experience, age and salary expected. Address Box 402, AMER. MACHINIST.

By a large, old established and modern equipped brass foundry, a thoroughly experienced and competent man to take charge of sales department, combining inside and outside work, on high-grade brass, bronze and aluminum castings; technical training and experience necessary; when writing, state age, training, experience and approximate salary required. Box 396, AMERICAN MACHINIST.

PENNSYLVANIA

Wanted—Foreman of machine shop employing 55 men; must be familiar with paper-mill machinery. Address Box 383, AMER. MACH.

Wanted—Ten machinists, general machine and bench hands; also two A-1 patternmakers. Apply to Scottdale Foundry and Machine Co., Scottdale, Pa.

Wanted—An experienced cost clerk familiar with machine-shop details; must be quick and accurate; state age, references and salary wanted. Box 397, AMERICAN MACHINIST.

Wanted—Tool, die and instrument makers; also a number of operators on large machine tools. Address Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—Fitters and vise hands for machine-tool work; steady employment and good wages to first-class workmen. Address Colburn Machine Tool Co., Franklin, Venango County, Pa.

Wanted—Man who is competent to develop sheet-metal problems and lay out a general line of tank, flue and hopper work; give reference and state wages expected. Hendrick Mfg. Co., Carbondale, Pa.

Draftsmen — Wanted, experienced draftsmen in electrical apparatus, switchboards, transformers, motors and generators; only first-class men need apply; state experience and salary expected. Address Chief Draftsman, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Wanted—Machine-shop foreman wanted to take full charge of all vise work (small high-grade interchangeable parts) in large manufacturing plant; must be thoroughly able to get the maximum amount of work out at a minimum cost; very good opportunity for the right man; state qualifications, salary expected, and references. Box 362, AM. MACH.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: Character, common sense, experience with automatic machinery (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND

Wanted—First-class draftsmen and tracers wanted on small automatic machinery; those having experience on typesetting machines preferred. Box 405, AMERICAN MACHINIST.

Toolmakers wanted — First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

WISCONSIN

Wanted — Strictly high grade automatic screw-machine operator; state experience, give references and wages expected; steady employment on good work. Address P. O. Box No. 1590, Milwaukee, Wis.

Wanted—Experienced storekeeper in plant manufacturing heavy machinery and employing about 1200 men; write immediately, stating experience, age and salary desired. Address Box 408, AMERICAN MACHINIST.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

WEST OF MISSISSIPPI

The J. Geo. Leyner Eng. Wks. Co., of Littleton, Colo., are increasing their plant and are in need of good mechanics, machinists, blacksmiths and sheet-iron workers. Littleton is a suburb of Denver, where cost of living is reasonable; superb climate the year round. Address above.

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DRAWING-OFFICE PRACTICE OF THE GENERAL ELECTRIC COMPANY

Sizes, Titles, Indexing and Conventions Used in the Largest Drawing Offices in this Country

BY JOHN W. UPP

GENERAL DRAWING-ROOM INSTRUCTIONS

Office Hours—Daily 8 a. m. to 5 p. m. except Saturday, 8 a. m. to 12:30 p. m. Lunch hour, 12 m. to 1 p.m.

Dates and Signatures (for purposes of identification)—Do not start work on a sketch or layout until you have signed and dated the sheet, and have added the rating of the apparatus. Completion date to be given when drawing is finished.

Check Your Work—You must assume entire responsibility for the accuracy of your drawings. A record is kept of errors, including those located by the inspector, and this record is always consulted when your compensation is under consideration.

Sizes of Drawings—K. 8x10½ used for reference purposes only. M. 12x18 standard. T. 24x36 semi-standard. P. 18x24 standard. W. 36x48 special.

The class letter is used as a part of the drawing number, thus, M 181176.

A ⅞-inch clear margin is left on all sides of T and W, and ½ inch on P and M drawings.

In selecting the size of sheet be guided by general practice and the special requirements of your work.

Angle of Projection—Third angle projection will be standard. Other arrangements of views will be permitted in special cases, but should be plainly designated as "Front View," "Looking in direction of arrow A," or similar terms, which will admit of no misunderstanding.

Titles & Material Specifications—Titles are placed in the lower right-hand corner of the sheet, and for outlines and assemblies give the specific name and the rating of the apparatus only as in Fig. 1.

Detail Titles include in addition to the specific name a list of all material necessary to make one complete part. Sample reduced size detail drawing is shown in Fig. 2.

Methods of calling for standard parts which need no delineation, but which are required in the complete machine, are shown in Fig. 3; also note parts 4 and 6 on sample drawing, Fig. 2.

Groups—To avoid a multiplicity of drawings and insure economical manufacture, parts which are made up from similar details, are grouped on one drawing, the first arrangement being designated as G-1; 2nd, G-2, etc., see sample drawing, Fig. 2.

Drawing Numbers—Drawings are serially numbered. The number is placed in lower right-hand corner of the title. The number is not used as a means of classifying the apparatus, but only to identify drawing in file. The identification of apparatus is obtained through the drawing list, the uses of which are explained below:

Letters and Figures—Standard letters and figures are shown in Fig. 4.

Abbreviations—Abbreviations are to be used only when lack of space prevents the use of the complete word. For list of standard abbreviations, see below:

SECTION OF DRAFTING DEPARTMENT, SCHENECTADY WORKS, GENERAL ELECTRIC COMPANY

Alloys (See Sheet 2)	
Aluminum	Al.
" Sheet	Al. Sh.
Asbestos	Asb
Asphaltum	Asph.
Babbitt Metal	Bab. M.
Brass, Half Hard	Br. ½ Hd.
" Hard	Br. Hd.
" Low	Br. Low
" Red	Br. Red
" Rod	Br. Rod
" Strip	Br. Str.
" Sheet	Br. Sh.
" Spring Hard	Br. Spg. Hd
Bronze	Brz.

GENERATOR	M.P	6-500	L	250	400	
MACHINE	TYPE	CLASS	FORM	VOLTS	AMPS	
OUTLINE						
BEGUN BY			TRACED BY			
FINISHED BY			INSPECTED			
GENERAL ELECTRIC CO. SCHENECTADY N.Y.						

FIG. 1. SAMPLE TITLE

Bronze, Tobin.....Brz. Tob.
" Phosphor.....Brz. Ph.
Cambric, Varnished.....Cam. Var.
Canvas.....Can.
Compound H.....Compd. H
" L.....Compd. L
" S.....Compd. S
" Red.....Compd. Red
Copper, Annealed.....Cop. An.
" Cast.....Cop. C.
" Drop Forged.....Cop. D. F.
" Half Hard.....Cop. ½ Hd.
" Hard.....Cop. Hd.
" Rod.....Cop. Rod
" Soft.....Cop. Sft.
" Spring.....Cop. Spg.
" Sheet.....Cop. Sh.
Copper, Tinned.....Cop. Tin'd
" Tube.....Cop. Tube
Fiber, Black.....Fbr. Blk.
" Horn.....Fbr. Hn.
" Red.....Fbr. Red
" Tube.....Fbr. Tube
German Silver.....Ger. Sil.
Glass.....Gl.
Granite Reconstructed.....Gr. Recon.
Iron, Common Sheet.....I. Comm. Sh.
" Cast.....I. C.
" Corrugated.....I. Corr.
" Forged.....I. F.
" Galvanized.....I. Galv.
" Malleable.....I. Mal.
" Refined.....I. Ref.
" Russia.....I. Rus.
Iron, Soft Cast.....I. Sft. C.
" Wrought.....I. Wrt.
Lignum Vitae.....Lig. Vit.
Leather.....Lthr.
Leatheroid.....Lthrd.
Lead Sheet.....Ld. Sh.
Metals (See Table of Alloys)
Maple, Kiln dried.....Mpl. Kd.
Mahogany.....Mgny.
Marble, Blue Vermont.....Mar. B. Vt.
" Red Tennessee....Mar. R. Tenn.
Platinum.....Plat.
Plaster Paris.....Pl. P.
Porcelain.....Prcln.
Press Board.....Press Bd.
Rubber, Hard.....Rub. Hd.
" Molded.....Rub. Mld.
" Packing.....Rub. Pkg.
" Soft.....Rub. Sft.
Slate, Black Enameled.....Sl. Blk. E.
Steel Casting.....S. C.
" Cold Rolled.....S. C. R.
" Drop Forged.....S. D. F.
" Forging.....S. Forg.
" Machinery.....S. Mch.
" Nickel.....S. N.
" Plate.....S. P.
" Spring.....S. Spg.
" Stamping.....S. Stp.
" Sheet.....S. Sh
" Tool.....S. T.
" Tube.....S. Tube
Sulphur.....Sulph.
Vulcabeston.....Vulcbn.
Wire, Brass.....W. Br.
" Copper.....W. Cop.

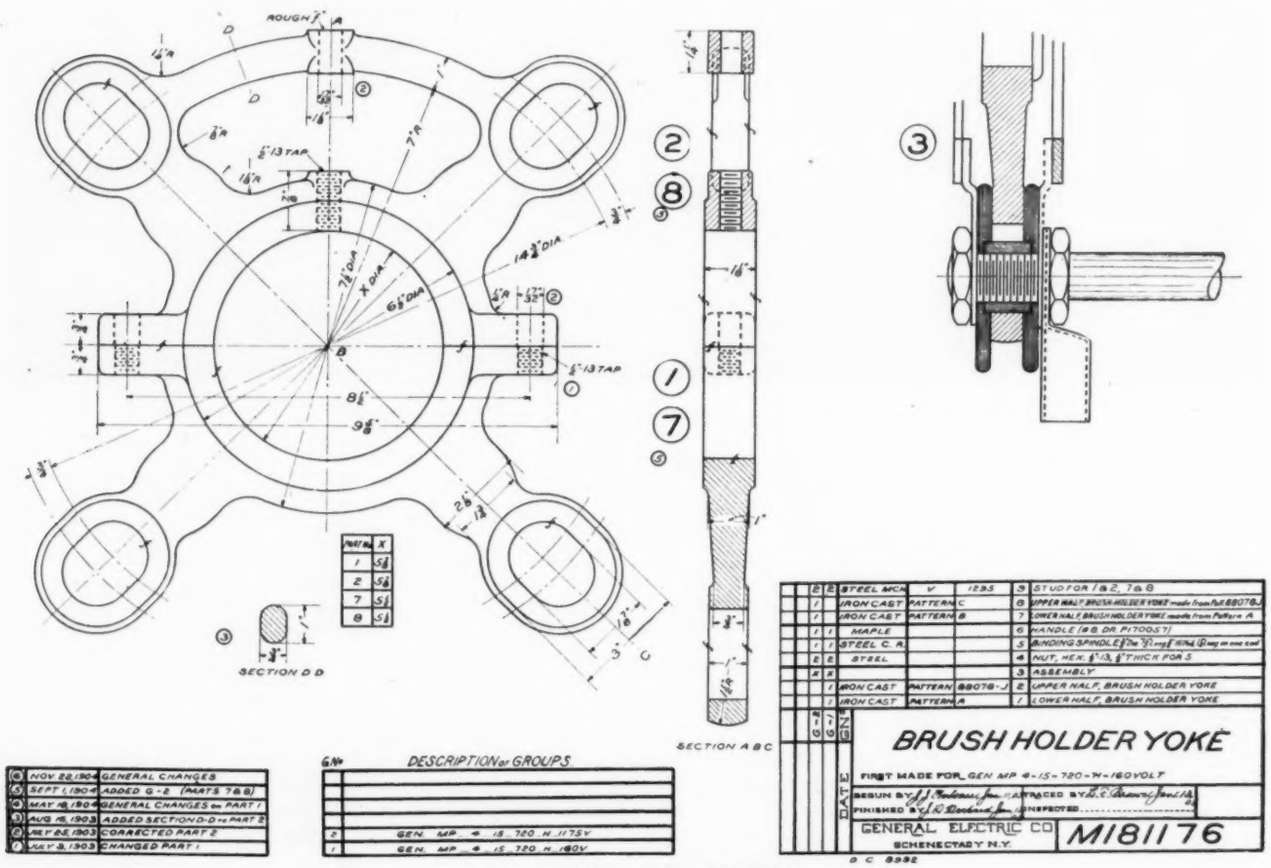


FIG. 2. SAMPLE DETAIL DRAWING

Wire, Copper, Double Cotton Covered.....W. Cop. D. C. C.
Wire, Copper, Single Cotton Covered.....W. Cop. S. C. C.
" Music.....W. Mus.
" Phosphor Bronze.....W. Ph. Brz.
" Spring.....W. Spg.
" Steel.....W. S.
Wood, Hard.....Wd. Hd.

Cross Sections—Plain cross sections of all material will be used on detail drawings. When, however, it is deemed advisable on assembly drawings to show kind of material by character of cross section, use sectioning shown in Fig. 5.

Dimensions—Dimensions of 24 inches or less are to be marked in inches thus: (").

Dimensions above 24 inches will be marked in feet and inches; feet should be represented thus (ft.) and not by accent mark (').

When micrometer or gage measurements are required, dimensions will be given in three-place decimals.

Drilled holes when less than ¼ inch in diameter are to be dimensioned in decimals; the drill number will be given, but will be inclosed in parenthesis to show that it is for reference only.

Drilled holes ¼ to 2 inches in diameter will have the word "drill" immediately following the dimensions, thus: ½" drill.

Holes above 2 inches in diameter will show finish marks, and method of obtaining hole will be left to the discretion of the shop.

When cored holes are desired, the word "core" will be added directly after the dimensions, thus: ¾" core.

Holes that are to be machined and cored will be dimensioned thus: Core to finish 1½", or core 1¼" to finish 1½".

Threaded parts will be dimensioned thus: ½-13 thd.

Tapped holes will be dimensioned thus: ½-13 tap.

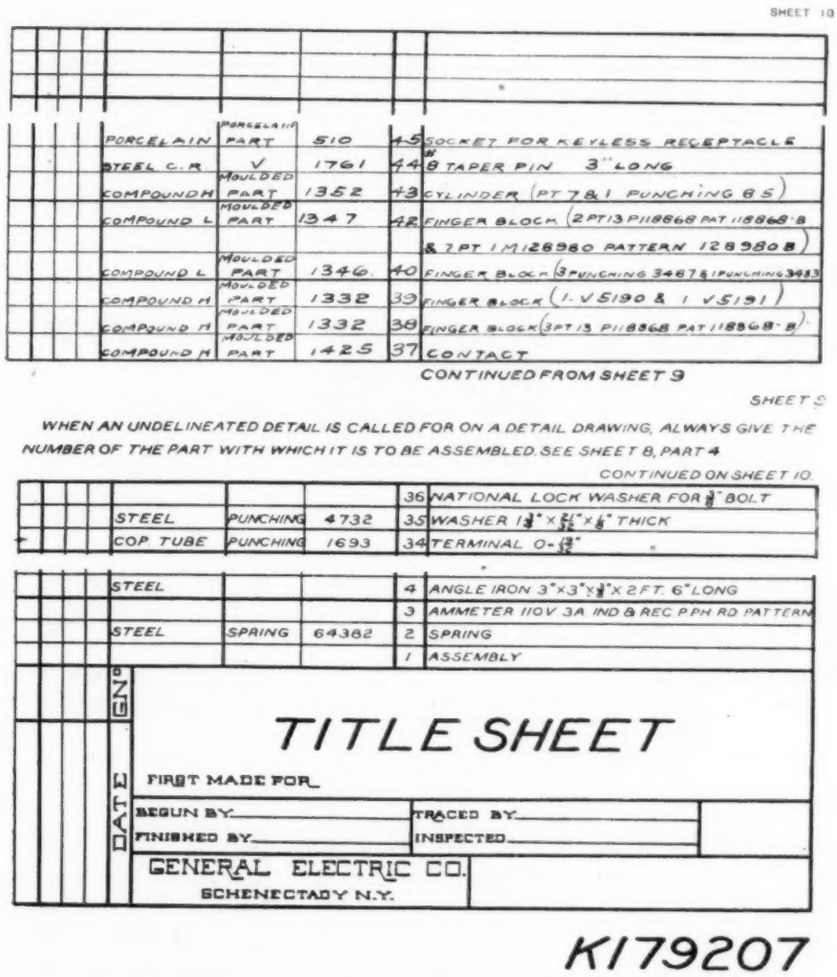

SHEET 10
PORCELAIN PART 510 45 SOCKET FOR KEYLESS RECEPTACLE
STEEL C.R V 1761 44 8" TAPER PIN 3" LONG
COMPOUND H MOULDED PART 1352 43 CYLINDER (PT 7 & 1 PUNCHING 65)
COMPOUND L MOULDED PART 1347 42 FINGER BLOCK (2 PT 13 P118868 PAT 118868-B & 1 PT 1 M 128980 PATTERN 128980 B)
COMPOUND L MOULDED PART 1346 40 FINGER BLOCK (3 PUNCHING 3467 & 1 PUNCHING 3433)
COMPOUND H MOULDED PART 1332 39 FINGER BLOCK (1-V5190 & 1 V5191)
COMPOUND H MOULDED PART 1332 38 FINGER BLOCK (3 PT 13 P118868 PAT 118868-B)
COMPOUND H MOULDED PART 1425 37 CONTACT
CONTINUED FROM SHEET 9
SHEET 9
WHEN AN UNDELINEATED DETAIL IS CALLED FOR ON A DETAIL DRAWING, ALWAYS GIVE THE NUMBER OF THE PART WITH WHICH IT IS TO BE ASSEMBLED. SEE SHEET 8, PART 4
CONTINUED ON SHEET 10
36 NATIONAL LOCK WASHER FOR ⅜" BOLT
STEEL PUNCHING 4732 35 WASHER 1⅜" X ⅝" X ⅛" THICK
COP. TUBE PUNCHING 1693 34 TERMINAL O-⅜"
STEEL 4 ANGLE IRON 3"X3"X⅜"X 2 FT. 6" LONG
3 AMMETER 110V 3A. IND & REC. P.PH RD. PATTERN
STEEL SPRING 64382 2 SPRING
1 ASSEMBLY
ENG.
TITLE SHEET
DATE
FIRST MADE FOR
BEGUN BY
TRACED BY
FINISHED BY
INSPECTED
GENERAL ELECTRIC CO.
SCHENECTADY N.Y.
K179207

FIG. 3. METHOD OF CALLING FOR PARTS WHICH ARE NOT DELINEATED ON DETAIL DRAWINGS

Thickness of any kind if wire or sheet metal will be given in decimals.

Finishes—Finish marks should be shown on the edges of surfaces to be finished whenever that edge is clearly shown in an exposed position.

Finish marks:

"f" indicates machine finished surfaces.

"f all over" indicates machine finish all over.

"File f" indicates file finish.

"Buff f" indicates buff finish.

"Rough f" indicates rough finish.

All special finishes must be clearly stated upon drawing without abbreviation or symbol.

Lines—Surface lines, dimension lines, center lines, etc., are to be made as follows:

Surface and cutting plane lines————
Hidden surface lines— — — — —
Dimension lines———— ———— ————
Center lines———— · ———— · ———— · ————

Part Numbers—Part numbers should be ¼ inch high, thus:

2, 3

and be inclosed by a circle ½ inch in diameter, thus:

Part numbers on assembly drawings should be inclosed by circles ¼ inch in diameter, thus:

Pattern Numbers—A pattern number is the number of the drawing upon which it is first shown with a letter annexed. See Sheet 8, Part 1. In case it is taken from another drawing, see Part 2; the word "pattern" will precede pattern number or letter.

References—New drawings must not call for parts detailed on other drawings, unless one reference gives complete information, except in cases of table drawings where a number of cross references may be made.

Changes—Changes are to be consecutively numbered. The number is to be placed as near as possible to dimensions changed, all changes made at the same time having the same change number. The number is inclosed by a circle 3/16 inch in diameter. If there are more than three or four changes on one part, the circle should be adjacent to the part number, and the change record call for general changes on that part.

Changes are recorded in table form, are placed in lower left-hand corner of drawing, and are made in the following terms: Added, changed, corrected, erased, rescinded.

Before changes are made, proper authority must be obtained and records must be consulted.

Special attention must be given to method of changing punchings, pattern and molded material numbers, also casting and material list.

Part Drawings—Single-piece drawings are for molded, porcelain, punched and screw-machine parts, and similar details. These drawings are serially numbered, and the parts delineated are known by this number, which is preceded by the name of part, as Molded Part—432721, the screw-machine parts numbers being preceded by the symbol V instead of the full name, as V—437832.

These parts are called for in the titles of detail drawings, the number being placed in the same column as the pattern number and the name in the preceding column. See sheets 9 and 10 Fig. 3, lines 34, 37, 43, 44 and 45.

FIGURES
1234567
1234567890
DECIMALS .025
FRACTIONS 3/4 15/16
(FRACTION LINES MUST BE HORIZONTAL)
TYPE 1 ABCDE
2 ABCDEFGHIJ
3 ABCDEFGHIJKLMNOI
4 abcdefghijklmnopqr
THE OVAL IN TYPE 4 IS SHAPED THUS: O AND WHEN INVERTED O. THIS OVAL OR PART OF IT IS USED IN THE FOLLOWING LETTERS IN THE MANNER INDICATED:
abcdeghjmnpq
THE SLOPE FOR ALL TYPES IS ABOUT 70° THUS:
I 70° H 70° M 70°
TYPES 1, 2, & 3 TO BE USED FOR TITLES.
TYPES 3 OR 4 TO BE USED FOR BODY OF DRAWING.

FIG. 4. STANDARD LETTERS AND FIGURES, FULL SIZE

Notes—Explanatory notes may be used when complicated designs are shown, if they will assist the workman in reading the drawing; but they must be brief, clear and concise, and must not be added unless there is no convenient way of giving the information by the delineation alone.

Drawing Lists—A drawing list is an index of all drawings used in the manufacture of the complete machine. The number of the drawing list identifies the apparatus. The catalog is cross indexed under serial number, rating of apparatus, and where advisable under customer's name and location. See sheet 12, Fig. 6.

Sketches and Special Drawings—There are several methods of issuing hurried instructions, each one of which covers a particular field, and is explained as below.

Sketch Books—Each drawing-room foreman is provided with a sketch book; these books are made up of sheets of cross-section paper serially numbered. The sketch is duplicated on corresponding loose pages by means of carbon paper.

As the sketch book information is always confirmed by a regular drawing, and it is only intended for advance information, and for hurried changes and corrections, all formality may be dispensed with. Drawings may be made free-hand, or in any way that will get the information desired into the proper hands in the shortest possible time. The department inspector will put his initials on each page when it is ready to be issued, doing this to insure his knowledge of the change when he is checking the tracing for issue or re-issue. The loose sheets are sent with the sketch book to the factory foreman, who personally signs for them. When the confirming drawing is issued, proper notation is made in the sketch book.

Bond-Paper Drawings—For all simple experimental and routine requisition work, cross-section bond paper can be used. Drawings are made in pencil only. Details may be drawn free-hand if time and expense can be saved by so doing. Each part delineated must be clear and properly dimensioned, and it must not be forgotten that haste and lack of attention to delineation may cause more confusion in the factory than can be offset by any apparent gain in the drawing room. Duplicates of the drawing may be made by means of carbon paper, and these duplicates will be handled by special messenger, being sent to the chief inspector and the blue-print department for such attention.

Drawings made in this manner are very poor for blue-printing purposes, especially after they have been in the vault files for any length of time. Their use, therefore, must be confined to work which is not intended for regular production, and which is not likely to require the frequent duplication of blue-prints. They have been found most useful for experimental work, which precedes regular production, and for small changes in standard apparatus to meet an individual customer's requirements.

Mimeograph drawings—Mimeograph drawings cover much the same ground as

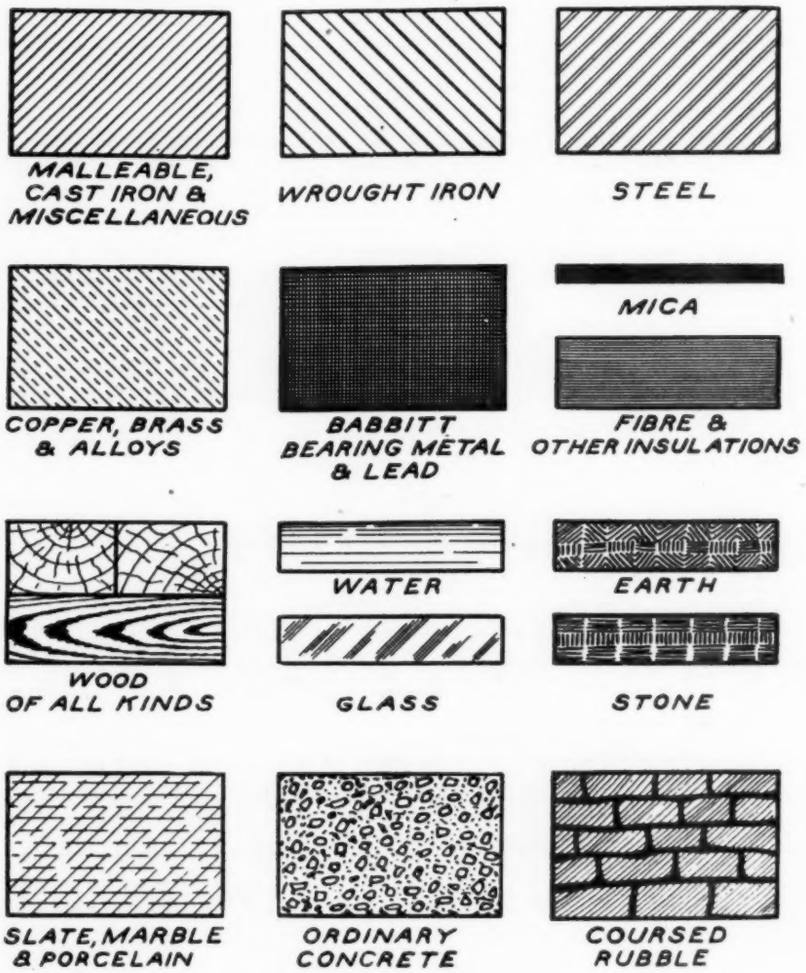


FIG. 5. STANDARD CROSS SECTIONS

bond-paper drawings, except that they admit of a much larger number of duplicate prints. Drawings can be made with indellible pencil or mimeograph ink. In general the duplicates have a better appearance than those made with carbon paper, but have the disadvantage that changes and additions are much more difficult. This form of drawing has been found of particular advantage for simple switchboards, connection bars, transformers, cabinet panels, and work of a similar nature.

Echoes from the Oil Country—The Hardest Job for a Machinist—Some Trials of Workmen and Foremen and Some Peculiarities of Individuals

BY W. OSBORNE

"What sort of a job do you think is the hardest for a machinist?"

That is a very hard question for a man to give a definite answer to, for much depends on the man, the shop and the circumstances. The hardest job that I recollect having physically was to keep at it without rest for 34½ hours. It was on a very important breakdown job. A cylinder belonging to a large engine in a mill had been wrecked and the mill was at a standstill until a new one could be made. When I say large I mean large for that shop. The engine was two hundred horse-power. Although the mill was several hundred miles from the shop the cylinder was so badly wanted that it was ordered to be forwarded by express.

General Electric Company, Schenectady, N. Y., U. S. A.

COMPILED BY A. B. FULLER — DATE — DRAWING LIST No. 00 — SHEET 12

INSPECTED BY W. C. DEAN — AUG. 13 04 — ... SHEETS SHEET NO. — COMPLETED

FIRST MADE FOR	MACHINE	TYPE	CLASS	FORM	VOLTS
	SYN. MOTOR	A.T.B.	10-200-500	5 & S	2200 / 8500

NAME OF DRAWING		DRAWING OR LIST NO.	GROUP OR PART NO.	NO. OF PARTS	DATE ADDED	DATE CHANGED
ASSEMBLY						
ARMATURE Punching		M183302	G1			
Spider (Stationary)		953/9-473	G3			
Winding		M183315	G1			
Winding Diagram		92756-466	PART 1			
BASE						
BEARING 5 x 15	TABLE	77381-255	SC 8 AR10E G1	2		
BEARING						
BRUSH	TABLE	M115333	G6	4		
BRUSH HOLDER	TABLE	R144642	G4	2		
Stand						
Stand Support						
Stand Bracket						
Studs & Connections	TABLE	79650-275	G21			
Yoke		M184017	G1		8-29-04	
CABLE for Armature 48000 SPEC. INSUL.						
For Field		82500-298	103	2	8-25-04	
Coupling	TABLE	M146117	G4	3		
COLLECTOR	TABLE	R144278	G18			
CONNECTION BOARD	TABLE	81312-292	BJ 200			
COUPLING (FLEXIBLE) FOR MOTOR	TABLE	100894-527	AH 45	2	8-25-04	
FIELD SPIDER (Revolving)		P191383	G1		8-22-04	
Ring (Revolving)						
JACK SCREWS		M184049	G1		8-23-04	
LAMINATED POLE PIECE						
PULLEY						
RAILS						
SHAFT & KEYS		M183352 M183352	G1		8-22-04	8-25-04
SPOOL COIL & CONNECTIONS		M183353	G1		8-25-04	
STANDARDS & CAPS		M187228	G1	2		
STANDARDS & CAPS						
WRENCH						
ARMATURE SPIDER & HELDS		92508-461	G6		8-22-04	
SUB BASE		M184027	G1		8-25-04	
FLEXIBLE COUPLING FOR ARC GEN.		10108-527	G7	2	8-25-04	
WOODEN BASE FRAME		P192000	G1		8-29-04	
LIST OF CASTINGS			0			
ENGINEERING NOTICE		76061				
ARMATURE WINDING	SPEC.	A 50445				
FIELD WINDING	SPEC.	F40593 F40994 M184334				
OUTLINE					33-04	34-04

A.C. — FORM 705 S.W. A.C. GENERATOR

FIG. 6. DRAWING LIST

Cross-section Tracing Cloth—Cross-section tracing cloth has been prepared for drawing room designers and draftsmen who are laying out work. This tracing cloth can be used by those who can make legible ink free-hand sketches of machine details. To those who are proficient, there is unquestioned economy in the production of drawings in this manner, but the drawing-room foreman should only permit its use when he is convinced that delineation will be clear and the work speedily completed.

WORKING OVERTIME

This shop had made the engine, and the order was to get the job done in the quickest possible time. From the time the casting struck the shop until it was in the express car it was kept moving. I was setting up engines at the time and had to chip the ports, scrape the valve and seat, and without a face plate, lay out all the holes and see that they were drilled and tapped properly, fit up the piston head, grind in the cylinder head, and give it the finishing touches generally. The shop was without a crane of any kind, and to move the casting we had either to use bars and rollers or rig up a set of blocks over head and hoist it onto a truck and when we had it moved we had to rig up again to get it down onto the floor.

As this was only the second or third engine of this size that the company had built, and was the largest they had ever undertaken, they were not very well prepared for getting the work out quickly. The only drawings were made with pencil on manila paper and were not as complete as might have been desirable.

I did my regular work through the day with one eye on the cylinder to see how it was progressing my way. It was not a great ways off from quitting time in the evening when I got it, and I worked and sweated and lifted and tugged on it all night. While it was at the drill press in the morning I hurried out to a nearby restaurant, and got some breakfast. It was nearly six o'clock that evening when I gathered up my tools after seeing the cylinder safe in the express car, and I was so tired that I do not think I cared whether that car got wrecked or not.

That might not have been hard for some other men. I did it because I had to or risk losing my job. I knew a helper in the same shop who once, when the shop was running a night turn, from choice put in a hundred hours in a week besides cooking his own meals at home. He did not seem any the worse for it and claimed that he did not feel tired except in his feet. I know that he did good faithful work at night.

AN ERECTOR'S ERROR

There is another kind of a job that even a good man has to do once in a while and unlike most jobs the better the man is the harder the job is for him to do. You may think that a good man would be glad to get a hard job, but I never heard of any kind of a man who liked this kind of a job, although sometimes I have seen a man who tried to make us believe that he did not mind it very much.

A shop that built a very good steam engine used to fit it up in various ways according to the use it was intended for. Once they had an order for one that was

to be used in a sawmill. This was a high-speed engine and the purchaser ordered it fitted up so that he could put a circular saw on one end of the crank shaft. The crank disk went on the other end and the pulley, eccentric and fly-wheel went between. To make sure that the saw would not slip, one saw collar was welded on so that it was part of the shaft. The crank disk was to be put on at the mill. A man was sent from the shop to put the engine together and start it. He warmed the disk and slipped it on and after it was fast he thought of the other things that belonged on the shaft and which should have gone on first. Although he saw that he had made a mistake he kept his nerve. "Now that we are sure," said he, "that this is a good fit, as it should be, we will take it off again and put the rest of the stuff on." In spite of his nerve and all of his efforts that disk stayed on and he had to go back to the shop with it. I can't imagine him getting a job that would be harder than taking that back to the shop.

SHIRKING A DIRTY JOB

Once in a while a man may be found who will "lay down" under some disagreeable job; but most machinists are not built that way, and a man who does it is generally sorry for it afterward. I remember an old machinist who told me of a job he had shirked when a young man, and he said that he had always felt ashamed of himself for it.

He was a young man just out of his time and had quit the shop where he learned his trade and started out for himself. He wandered into a jobbing shop. The tools were old and the shop was dirty. The men were as dirty as the shop and the work was rough. He felt and perhaps showed a certain amount of contempt for the foreman, who seemed to doubt his ability to hold his own with the men, but he was given a trial. He was given a planer to run. It was one of the oldest inhabitants. The table was dragged back and forth by means of a chain, and he had not worked a great while before that chain let go somewhere. To find out what was the matter and see how to fix it it was necessary to get under the planer. The way to do this was to lie down face up and crawl under. The floor was very dirty and judging from the appearance of the parts of the planer that could be seen the parts that could not be seen had never been cleaned. As he was looking things over, probably with his nose tilted to an angle of forty-five degrees, he heard one of the men snickering, and he imagined how he would look after being under there in the dirt. A look around showed that the foreman was not in sight, and he picked up his tools and walked out and never went back. "If I had it to do over again I would fix things up if I spoiled the only suit I had in the world, and I would run the machine until I showed them that I could run it before I quit," was the way he wound up. "I went after the job and took it and it was a cowardly thing for me to go off without first telling the man that I hired out to that I was going."

A NERVOUS MACHINIST AND A COOL-HEADED ONE

It is a hard job for some men to work when someone is watching them. It was very warm and the new man was sweating very freely as the foreman stopped to see how he was getting along. He had not stood there very long before the man straightened up and wiped his brow. "Have you anything you want to say to me or any suggestions or anything?" he asked.

"No. You seem to be getting along very well for the time you have been here," was the reply.

"All right then, if you will only go away and let me alone I will get along better. I am not saying that to be saucy, but if you stand and watch me like that I will go all to pieces. If there is any way to get a job wrong I'll get it wrong if you stay there."

That man's hard job seemed to be having to work with someone watching him. Many good workmen find it very trying to go to work in a strange shop, and never do themselves justice for the first few days from pure nervousness or "stage fright."

"I would like it if you would come around once in a while and look over my work," remarked a man to his foreman. "I know that I can suit you if I only know what you want. I can work lots better when the foreman acts as if he was interested in what I am doing. If he never comes 'round I sort of lose interest in things myself. I would rather have you come around and find fault once in a while if you are at all reasonable, than not have you come at all."

The way that Dave would brighten up whenever the foreman found time to pay him a visit showed that he meant what he said.

A FOREMAN'S HARDEST TASK

Many a foreman who is a success finds that his hardest job is to figure out the dispositions and capacities of his men and then so act himself that he will make it natural for them to do their best.

One foreman had a man who seemed to him rather peculiar. He was a good workman, quiet and orderly, but the foreman thought him rather irritable. On one occasion when he was being shown how they had found it best to do some work he flew into a great passion without any apparent reason, to the surprise of the foreman. In a few minutes he cooled down and apologized for his behavior and continued his work. As his work was satisfactory the foreman wanted to keep him, and became very careful of the way he approached him and gave orders or instructions. One day, after several weeks, the man quit. His reason was that he thought it the only decent thing for him to do. He had formed such a personal dislike for the foreman that he seemed unable to control it, and yet he could see the effort that the foreman was making to make it pleasant for him, so to even things up he quit.

The foreman felt that handling that man properly was one of his hard jobs and that he had made a failure of it. To control his temper might have been the other man's job.

A Method of Indexing and Numbering Tools

BY LINWOOD A MURRAY

Some time ago I entered a position as assistant to the superintendent of a shop of no great size, which was engaged, or was about to engage, in the manufacture of a small machine requiring extremely high-grade work in considerable quantity. My nominal position was that of draftsman, but in addition to my duties as such, there developed upon me almost the entire work of systematizing the methods in the place.

THE OLD METHODS

The shop had been in partial operation for some time, but everything had been done on the hit-or-miss plan, without the slightest attempt at system, and everything was generally in a condition which a friend of mine was wont to describe as "chaos chaotic." Parts were being manufactured, some by the use of tools and some without their use, the work all being done without any regard to system, and without any attempt at establishing the place on a departmental basis. The nearest approach to any division was found in the practice of parceling the men into small gangs under separate foremen. These gangs, however, were small shops in themselves, and did manufacturing and tool work indiscriminately.

The machine to be manufactured had just passed out of the experimental stage, and all work upon its parts was done from models and from such drawings as were at hand. The latter were generally of no value either through original error or change of design in the part concerned, so that the work proceeded with the hope that it might be, but with no assurance that it was right.

The tools in existence in general, represented the ideas or whims of the gang foreman or of the individual making them, and, as might be expected, some were good in design and many were bad.

To make matters still more complicated, the gang foremen were jealous of each other, and no opportunnty for "knocking" was allowed to pass unimproved. The resulting inefficiency and disorder can be readily imagined.

THE MODEL MACHINE

At the time of my arrival at the factory, six machines were nearly completed, one of which was finished a few days afterward, and was pronounced generally satisfactory. This machine was taken as a model from which to design and construct tools. It was also to be used as a standard of comparison for the making of gages and the manufacturing of future machines. While it was considered that this model might be and probably was faulty, it had two merits, viz.: it would do the work for which it was designed and made in a very satisfactory manner, and its use gave a standard for comparison and correction which did not exist under the previous method in which any part which appeared to be correct was used as a model for the manufacture of that sort.

The model was at once taken down, its parts named, numbered, and tagged, and a list made out for use in the drawing room. The tagged parts were hung on a rack, and when a piece was needed for comparison or for the purpose of making tools, the tag was removed and upon its back was placed the name of the man taking it. If for any reason a part was changed, the corresponding model part was immediately tagged *obsolete*, dated, and placed in a box provided for the purpose. To avoid continual tearing down and assembling of the model, it was intended to have the second of the six above mentioned machines for use as a comparison while assembled. Through the pig-headedness of the inventor and the short-sightedness of the manager, this end was not accomplished, much to the annoyance of those most immediately concerned.

NUMBERING THE PARTS

In numbering the machine parts, the machine was divided into sections or combinations named from the functions which they performed. Each combination was given a base number to which was affixed in every case the part numbers, which were consecutive—thus for the frame the combination base number was 100, the frame itself 110, the frame binding screws 111, etc. The other combinations bore base numbers 200, 300, etc., as required.

The next step was to take each part and decide upon, and make a record of, every operation necessary for the completion of the part, together with the kind of special tool or tools necessary for its manufacture.

In addition to this information, the record contained the names and numbers of the various machine tools upon which the various operations were to be performed and a statement as to the completion or nearness to completion of such special tools as were then started. Necessary tools not already provided for were put into a supplementary list to insure their not being forgotten.

NUMBERING THE OPERATIONS

The operations were recorded in their proper places and numbered consecutively, the numbers consisting of the number of the piece, composed as explained above, to which was affixed the number of the operation: thus on the frame, the first operation was cleaning, which included all the preparatory work of grinding gates and lumps, and of filing places inaccessible to the wheel. Its number was 1101. Such tools as were made at the time of the making of the list were numbered at once with the operation number. New tools were numbered at the time they were made, and were not accepted from the tool room as complete unless numbered. The numbering was further elaborated by designating minor special tools, such as drills, reamers, counterbores, etc., by the operation or tool number, to which was added a distinguishing letter, thus: 1102A, 1102B, etc.

THE CARD SYSTEM

In order to have the manufacturing carried along these predetermined lines, a series of cards was prepared on which was contained all necessary information regarding the manufacture of the parts of the machine. The first card, known as the General Information Card, was 5x7 inches in size, and contained, besides the name of the piece or part, the kind and size of the stock, weight of piece if a casting, or of a hundred if of sheet metal or rod, number of pieces to a machine, and pattern number. The card also contained a numbered list of the tools required for the piece. Fig. 1 shows the arrangement of the cards, of which two sets were furnished, one for the superintendent's office, and one for the general foreman.

Cards Nos. 2 and 3 were known respectively as the Operation Tool Card, and the Description of Operation Card. These cards were made in duplicate for the same purposes as was No. 1.

The Description of Operation Card was for use in such cases only as were peculiar, or in any way different from the ordinary methods of manufacture. For these cases, the details of the operation were all recorded upon the card, so as to insure the permanence of the method.

STORING THE TOOLS

Up to this time, the method of storing the tools had been of the crudest, they having been put into large trays or shallow boxes, some few being tagged, but generally without any means of identification. These trays had been put upon shelves without regard to order, so that any tool could be found only by carefully going through the lot.

To remedy this defect and to provide a safe place in case of fire, a fireproof vault, perfectly airtight, and furnished with the usual vestibuled doors, was built just outside of and opening into the shop. The vault was built entirely of concrete blocks, except the floor, which was of solid concrete, supported by I beams. On each side were placed two racks built of angle iron, and in the middle a case of drawers. This case was 8 feet long, and contained 60 drawers (30 on each side), all of equal length and breadth, but of graduated depth, i.e., the top drawers were shallow, the next row deeper, and each succeeding row of increased depth, to the bottom. The tools were then laid out and fitted loosely to carrying or holding boards or trays,

Article of manufacture, # 1 Trimming machine.
No. 110. Name of piece, Frame.
Material, Cast Iron. Size, Weight, 32 lbs.
Pieces to one machine, 1. Finish, Black enamel. Pat. No. 110.

Op.No.	Operation	Tool	Tool No.	Date Fin.	Date Ch'd.
1	Clean.				
2	Mill top.	Milling fixture.	1102	Apr. 3 '06	
3	Mill bottom and ends	" "	1103	Apr. 6 '06	
4	Drill all holes.	Drilling jig.	1104	May 4 '06	
5	Hand ream.	Reaming fixture.	1105	May 6 '06	
6	Wash.				
7	Finish for enamel.				
8	Enamel.				

FIG. 1. GENERAL INFORMATION CARD

No. 110. Name, Frame.
Op.No. 3. Operation, Mill ends and bottom.

Tools, Milling fixture # 1103. 2 cutters, 2" x 10" 1-½", # 1103 A. 2 cutters 3" x 3" x 1-½" # 1103 B. Arbor # 1103 C. Gauge # 1103 D.
Case No. 1. Drawer No. 1. Tray No. A.
Machine Tool, Hendey M.M. No. 219.
Cutting Speed, R.P.M., 26.
Feed, .125" per revolution.

FIG. 2. OPERATION TOOL CARD

which were multiples, in size, of the bottoms of the drawers. Thus, if a tool or set of tools for an operation took up an entire drawer, only one tray was necessary for the drawer. If, however, but one-half a drawer was needed, two trays, one-fourth drawer size, or one tray one-half drawer size, could be utilized. In this manner it was possible to have a considerable number of trays of various sizes in stock, so that tools, immediately upon their completion, could be placed in their proper places. A complete system of card indexing provided a rapid and easy method for finding and replacing any tool when taken out or returned.

While these improvements were of necessity expensive, and were spread over a considerable period of time, the resulting benefits in every way were felt to be ample return. They were a satisfaction alike to the office and to the shop.

Realistic Illustrating

When it comes to realistic illustrating the *Indian Electrical, Mechanical and Textile News* has all the other papers "skinned a mile." At page 40 of the October issue it has an account of a new cotton tree which has been discovered by J. R. Spence at Deesa, India, the product of which has been named Spence cotton. The tree attains a hight of over 12 feet with a trunk diameter of 12 inches. The life of the tree is stated to be over 20 years. The Spence cotton tree will produce 400 pounds of clean cotton per acre the first year, 800 pounds the second year, with an increase as the tree reaches maturity. The American cotton shrub, which has to be planted every year, produces about 250 pounds and the Egyptian about 500 pounds per acre. The staple of the Spence cotton is from 1¼ to 1½ inches long.

We now get down to the realistic illustrating: Instead of a blear-eyed halftone, a tuft of Spence cotton is gummed to a blank space left in between paragraphs. No misrepresentation there. It's the real stuff. You can pull it off, twiddle it in your fingers and see and feel just what it's like.

What a great scheme this would be for machine-tool ads! Think of the surprise and delight of getting the AMERICAN MACHINIST with a 20-foot boring mill glued to the front cover! But then our postal authorities will allow nothing but the AMERICAN MACHINIST to go within its wrapper.

Geo. Nash & Co., 217 Pearl street, New York, representatives of Seebohm & Dieckstahl, steel makers, Sheffield, are issuing a 58-page pamphlet entitled "Hints to Practical Users of Tool Steel." Thirty-eight pages of this booklet are devoted to heating, forging, hardening, tempering and annealing carbon, air hardening and high-speed steels.

A COST-ESTIMATING SLIDE RULE

The Drudgery of Calculations Eliminated

BY W. L. MIGGETT

When undertaking a piece of work of any kind, the prime question is: What will it cost? In large undertakings the most expensive engineering skill is employed to estimate the cost before construction is started, while in manufacturing articles in large quantities, the question of cost is studied carefully, each piece and each operation receiving individual attention. Between these two extremes lies a vast field where construction work is carried on more or less blindly, guess work taking the place of accurate cost determination.

The cost of the cost finding itself acts as a deterrent, preventing many otherwise progressive concerns from making serious effort in this direction. The need of accurate cost finding is of growing importance, and it is generally recognized that a concern that does not know what its product costs is not on a safe footing financially. For this reason, any device or plan that will facilitate estimating and cost finding should be of vital interest.

While engaged in considering ways and means for securing, filing and digesting detailed costs in the machine shop, I was led to an investigation whose object was the devising of an instrument, or system, for accurately, quickly and cheaply determining the cost of machining a unit of surface on castings and forgings. As the scheme developed, the best form of unit was seen to be one inch of tool travel, or work travel, as the case may be, considering the rate at which the work progresses by means of the feed. In turning a cylinder 30 inches diameter the unit of work will be a cylindrical surface 30 inches diameter, and one inch face. In linear work, such as planing, the unit will be a surface the length of the work by one inch wide. In milling, the unit will be one inch travel of the table and work past the cutter.

ELEMENTS OF THE PROBLEM

The rate or speed at which this cutting is accomplished constitutes the important element in the cost of the work produced, the rate of wages of the workman being the next in importance. If we know or assume the *cutting speed, feed, rate* of workman and the *size* of the work, a simple arithmetical calculation will determine the price for taking a cut over a given surface or piece. The *price* bears a constant or definite relation to the product of the *rate, feed* and *size* of work, divided by the *cutting speed.* Writing this as a formula we have:

$$Price \times a\ constant = \frac{rate \times feed \times size}{cutting\ speed},$$

or more briefly

$$C \times P = \frac{R \times F \times D}{S},$$

in which R = the *rate* of the workman in cents per hour.

F = the *feed* in revolutions per inch of tool travel.

D = the *diameter* of work or tool in inches or feet.

P = the *price* per inch of travel of tool rest.

S = the *cutting speed* in feet per minute.

C = a constant whose value depends upon whether D is expressed in inches or feet.

By means of this formula anyone with an ordinary knowledge of arithmetic can readily compute the cost or price for taking a cut over a given surface. A clerk can do it if given the proper rate, speed, feed and size of work. An experienced shop man is required, however, to correctly judge the proper speeds, feeds and cuts for various classes of work. Since his time is valuable, and the constant repetition of this computation would become drudgery to him, it is necessary to devise a shorter method.

Those who are familiar with the use of the slide rule can perform the multiplying and dividing required to solve this formula on the ordinary slide rule, thus shortening somewhat the labor involved. If a mistake is made, however, the whole process has to be gone over again. Many shop men are not familiar with the slide rule. These considerations led to the conception of an arrangement of slides bearing logarithmic scales, each of which performs one operation in the solution of the formula.

In devising the multiple slide rule shown in the illustrations, three distinct objects were kept in view. 1st. A slide rule that would not require a knowledge of logarithms to operate it. 2d. An arrangement such that the entire solution of the formula can be accomplished with one setting of the slides, thus enabling the operator to review the calculation for errors without performing the solution over again. 3d. An arrangement that will give, in effect, a rule where the manipulation of a single slide performs most of the work of computing, the remaining slides being in the nature of a magazine of adjustments for taking care of those factors, rate, speed and constant, which do not vary as frequently as the feed and size of work.

DESCRIPTION OF THE INSTRUMENT

In Fig. 1 is shown a multiple slide rule arranged to accomplish these results. The

rate and *constant* scales are marked on the body of the rule itself and are fixed with relation to each other. The three movable slides are let into the body of the rule, and are provided with tongues that prevent friction between the slides, permitting each slide to be moved independently of the others. The movable slides are held in place by a plate of transparent celluloid covering the entire face of the rule.

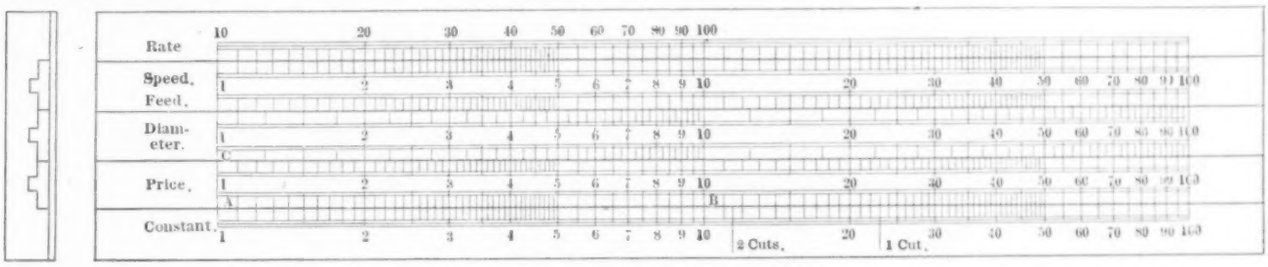


FIG. 1. COST-ESTIMATING SLIDE RULE

Fig. 2 shows the same arrangement in conical form, the moving slides being in the form of rings that turn on the body of the device, the logarithmic scales being marked on the conical surfaces.

Writing the formula

$$C \times P = \frac{R}{S} \times F \times D,$$

its solution by the rule is as follows: 1st. Set A or unity on the *price* scale opposite the proper value on the *constant* scale. This multiplies the constant by the price, giving $C \times P$, which is the solution of one side of the equation or formula. 2d. Set the proper value on the *speed* scale opposite the desired value on the *rate* scale.

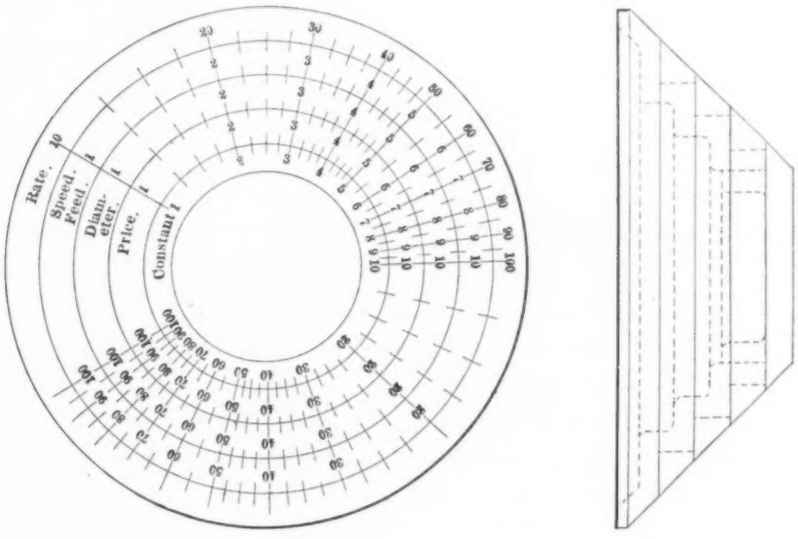


FIG. 2. COST-ESTIMATING SLIDE RULE IN CONICAL FORM

This divides the rate by the speed, giving $\frac{R}{S}$. 3d. Move C or unity of the *diameter* scale opposite the proper value on the *feed* scale. This multiplies $\frac{R}{S}$ by the feed, giving $\frac{R}{S} \times F$. 4th. Look forward on the *diameter* scale to the diameter of the tool or work. This multiplies $\frac{R}{S} \times F$ by the diameter, giving $\frac{R}{S} \times F \times D$, which is the solution of the other side of the equation. Since the two members of an equation are equal to each other, the *price* per inch of tool travel will be found on the price scale opposite the value on the diameter scale that applies to the particular piece of work. That is, the price is found at the point where the solutions of the two members of the equation balance each other.

APPLICATION TO PLANER AND SHAPER WORK

Thus far we have considered only circular work, where either the work itself or the cutting tool is circular in form, and where only circular motion is involved. This includes the operations of turning, boring, drilling and milling as performed on lathes, boring mills, drill presses and milling machines.

Linear work, as planing, shaping and slotting, can be as readily calculated on this slide rule as circular work, by substituting in the formula, *length of stroke* for diameter, and a *speed factor* for speed. This speed factor is found by dividing the product of the cutting-stroke speed and the backing-stroke speed by 3.14 times their sum; or the speed factor is

$$\frac{s \times S}{3.14\ (s + S)}.$$

The modified formula is

$$C \times P = \frac{R \times F \times L}{3.14\ (s + S)}$$

In order to use the rule with facility for computing linear work, a table should be made comprising the speed factors for all of the reciprocating machine tools in the shop, so they can be readily referred to. The speed factor can then be selected for the particular planer, shaper or slotter upon which any job is to be done. Table 1 is an example of such a table.

Cutting Speed. s	Backing Speed. S	Ratio. $\frac{S}{s}$	Speed Factor. $\frac{s \times S}{3.14\ (s + S)}$
20	40	2	4.25
20	80	4	5.10
30	90	3	7.16
40	80	2	8.50

TABLE I. SPEED FACTORS

In assuming or determining the length of stroke, a proper allowance must be added to the length of the work to permit the machine to reverse. To be accurate this should also be investigated for each machine and the results put in tabular form to be referred to in the same manner as the table of speed factors.

The values of the constant for a single cut are $C = 229$ when the size of work D or L is expressed in inches, and $C = 19.1$ when the size is expressed in feet. It will be noticed that one value is just twelve times the other. Since measurements of most of the work in a machine shop are expressed in inches, only the former value of C will be considered in the discussion and examples that follow.

COMBINATIONS OF ROUGHING AND FINISHING CUTS

It is very seldom that a piece of work is finished with a single cut. Two or more are usually required, one of which is a finishing cut, generally with a coarser feed, and sometimes with a higher or lower speed than the roughing cut.

When the rule is used to calculate the cost of a single cut over a surface, it will be necessary to perform further computations to secure the entire cost of the operation. In order to save this extra work of computation, the value of the constant C may be so varied that one solution or reading of the rule will give the cost per unit of surface with any combination of roughing and finishing cuts.

To illustrate: Two cuts will cost twice as much as one cut with the same feed and speed. If the value of C for one cut, 229, be divided by two, and this value 114.5 be used as the constant, the result will be the price for the two cuts. Fig. 1 shows two marks on the constant scale labeled *1 cut* and *2 cuts* respectively. These marks are located at the values 229, and 114.5, and are the proper points to set A or B on the price scale when computing the price of two cuts having the same speed and feed, and on the same piece of work. Values of C for all other combinations of cuts could be permanently marked upon the constant scale, were it not for the variation of feeds and speeds on roughing and finishing cuts.

Take the formula

$$C \times P = \frac{R \times F \times D}{S}$$

and write it again

$$C \times P = \frac{R \times 0.5\,F \times D}{0.75\,S} = \frac{R \times F \times D}{S} + \frac{2}{3}.$$

Then $C_1 = \frac{2}{3}\,C$, and

$$C_2 \times P = \left(1 + \frac{2}{3}\right)\frac{R \times F \times D}{S}$$

will be the formula for figuring the price of both cuts with one computation. From this we get

$$C_2 = \frac{C}{\left(1 + \frac{2}{3}\right)} = \frac{C}{1.66} = \frac{229}{1.66} = 138,$$

which will be the proper value of the constant to use in order to calculate the cost of these two cuts with one operation of the slide rule. This reasoning may be made to cover any number of cuts having any variation of feeds and speeds. A table of values of C should be calculated covering the methods or practice pursued in the particular shop under consideration, so that it can be referred to, the same as the table of speed factors for linear work. By this means the cost or price for finishing a unit of surface with any combination of cuts, feeds, and speeds, may be secured with one operation of the rule, using the feed and speed of the roughing cut when operating the rule. Table 2 gives a few examples worked out to illustrate this method of getting these values of the constant.

ROUGHING CUT.		SECOND CUT.		FINISH CUT.		DIVISOR.	VALUE OF CONSTANT
Feed.	Speed.	Feed.	Speed.	Feed.	Speed.		
$F = 32$	$S = 40$	$16 = 0.5\,F$	$50 = 1.25\,S$	$8 = 0.25\ F$	$32 = 0.8\ S$	$1 + \frac{0.5}{1.25} + \frac{0.25}{0.8} = 1.7125$	$\frac{229}{1.7125} = 133.0$
$F = 32$	$S = 40$	$32 = F$	$40 = S$	$8 = 0.25\ F$	$40 = S$	$1 + 1 + \frac{0.25}{1} = 2.25$	$\frac{229}{2.25} = 101.7$
$F = 32$	$S = 40$	$32 = F$	$40 = S$	.....	.....	$1 + 1 = 2$	$\frac{229}{2} = 114.5$
$F = 32$	$S = 40$	.....	.....	$8 = 0.25\ F$	$40 = S$	$1 + \frac{0.25}{1} = 1.25$	$\frac{229}{1.25} = 183.2$
$F = 24$	$S = 30$	.....	.....	$8 = 0.33\ F$	$40 = 1.33\,S$	$1 + \frac{0.33}{1.33} = 1.25$	$\frac{229}{1.25} = 183.2$
$F = 48$	$S = 60$	.....	.....	$8 = 0.166\,F$	$30 = 0.5\ S$	$1 + \frac{0.166}{0.5} = 1.33$	$\frac{229}{1.33} = 172.0$

TABLE 2. VALUE OF C FOR TWO AND THREE CUTS

We have now considered the theory of the rule and its system of operation, finding that to use it with facility, three reference tables are necessary. These tables, which each user will have to work out for himself from the conditions prevailing in his own shop, are values of the constant C, speed factors for reciprocating machine tools and allowances in stroke to permit these reciprocating machines to reverse.

FINDING TIME INSTEAD OF PRICE

It is often desirable to know the *time* required to finish a piece of work rather than the *price* for doing it; in fact, some prefer to record their cost data in the form of time limits for each operation on certain machines, leaving the rate of pay for the operator to be governed by varying conditions in the labor market. This slide rule will work just as readily to calculate the time of performing work by assuming the rate as 60, and using that value always in operating the rule. The reason for this is seen easily if we consider that when a man is earning 60 cents per hour, he is getting a cent a minute. The result will then be in cents or minutes, whichever way we want to read them.

The primary object of so arranging the slides of the rule that it can be operated by anyone not familiar with logarithms is seen to have been attained by the simple instructions for operation that follow.

INSTRUCTIONS FOR OPERATING

To find the *price* for circular work: 1. Set the desired *speed* opposite the desired *rate*. 2 Set A or B opposite the desired *constant*. 3. Set C opposite the desired *feed*. 4. Opposite the *diameter* of work or tool, read the *price* per inch of tool travel.

To find the *price* for linear work: Proceed exactly as before, except use *speed factor* for *speed* and *length* for *diameter*.

To find the *time* for circular or linear work, set *speed* or *speed factor* opposite 60 on *rate* scale, and proceed exactly as before.

With a little practice the operator can readily locate the decimal point, as the result may come out multiplied or divided by ten.

Another feature of the rule for saving time that needs explaining is that, having once set the price and feed and speed

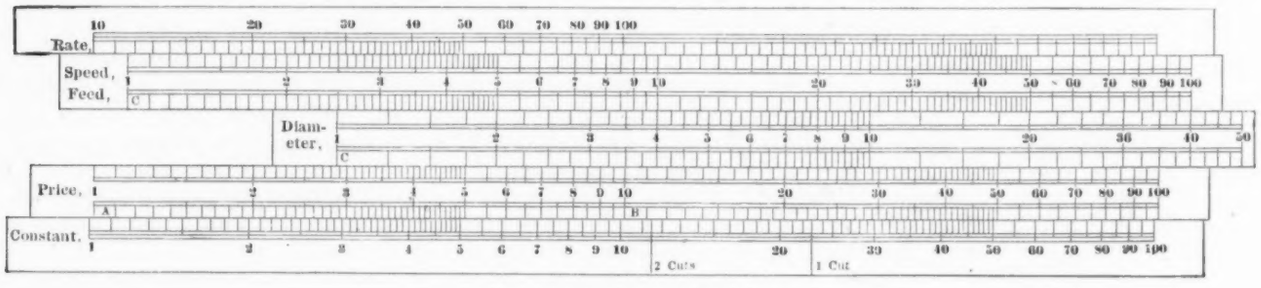


FIG. 3. SOLUTION OF PROBLEM 1

scales, the rate, speed and constant are fixed. The feed, diameter (or length) and price are the factors that are constantly changing with each piece of work, while the rate, speed and constant do not vary so often. It is then necessary to manipulate only the middle scale to take care of variations in the other factors. The feed and speed and the price scales can be provided with locking devices, when the

rule would become a single slide rule for doing actual calculation, while the two other slides could be moved from time to time in passing from one class of work to another. In this way it becomes a single slide rule from which prices may be read as fast as they can be written down, and having a magazine of adjustments to take care of variations in rates of pay, cutting speeds and combinations of cuts, or styles of grades or finish. Used in this way the rule would seem to be almost indispensable to cost computers and foremen of machine shops.

To further illustrate the method of computation by the use of this rule the following examples are worked out and illustrated by Figs. 3, 4 and 5, the slides being shown set in their proper positions for solving the formula in each case. These three illustrations will show how easily the computation may be reviewed for errors and corrections.

EXAMPLES

Circular work: Let *rate* = 35; *speed* = 30; *diameter* = 15; *feed* = 25; cuts, 2 rough and 1 finish; ratio of finish feed to roughing feed, $\frac{R}{F} = 4$;

$$constant = \frac{229}{2.25} = 101.7.$$

Operation. 1st. Set speed = 30 opposite rate = 35. 2d. Set unity *A* on price scale opposite 10.17 on constant scale. 3d. Set unity *C* on diameter scale opposite feed = 25. 4th. Opposite 15 on diameter scale, read price = 4.35 (about) on price scale. See Fig. 3.

Circular work: Let *rate* = 15; *speed* = 45; *diameter* = 2; *feed* = 60; cuts, 1 rough and 1 finish; ratio $\frac{R}{F} = 2$; *constant* = $\frac{229}{1.5} = 152.6$.

Operation. 1st. Set speed = 45 opposite rate = 15. 2d. Set 10 *B* on price scale opposite 15.26 on constant scale. 3d. Set unity *C* on diameter scale opposite 60 on feed scale. 4th. Opposite 2 on diameter scale, read price = 0.26 (about) on price scale. See Fig. 4.

Linear work: Let *rate* = 45; *cutting speed* = 40; backing speed = 80; then *speed factor* = 8.51. Let *length* = 26; *feed* = 25; cuts, 1 rough and 1 finish; ratio $\frac{R}{F} = 4$; *constant* = $\frac{229}{1.25} = 183.2$.

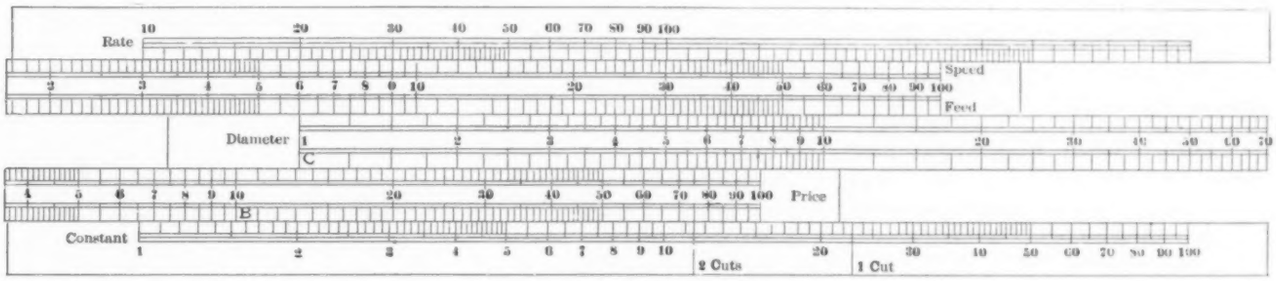


FIG. 4. SOLUTION OF PROBLEM 2

Operation. 1st. Set speed (speed factor) = 85.1 opposite rate = 45. 2d. Set unity *A* of price scale opposite 18.32 on constant scale. 3d. Set unity *C* on diameter (length) scale opposite feed = 25. 4th. Opposite diameter (length) = 36, read price = 2.6 (about) on price scale. See Fig. 5.

It will be noticed that in using the speed factor and constant the decimal point may be set over either to the left or right. This is sometimes necessary, especially with the speed factor, as its value is generally less than ten, while the speed when used direct, as in circular work, is usually between ten and one hundred. Facility in locating the decimal point must be acquired by experience in using the rule, which is about the only thing that seems defective in the rule and system of computing.

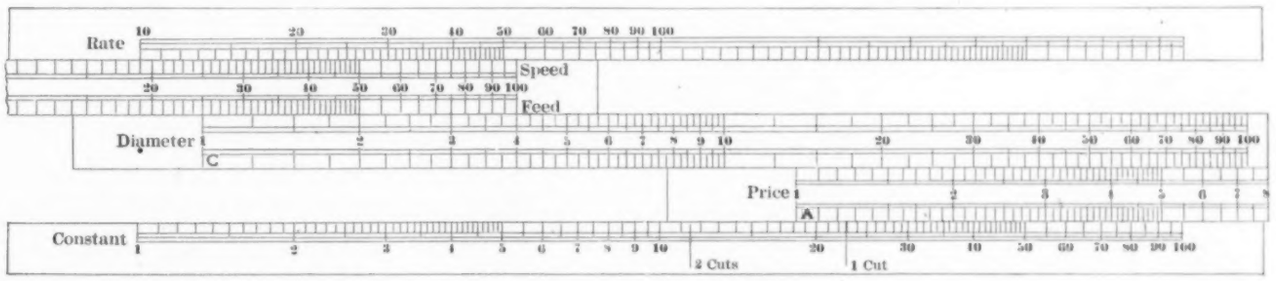


FIG. 5. SOLUTION OF PROBLEM 3

The rule is arranged to determine the cost of one inch of tool travel in machining any surface. To find the total cost it is necessary to multiply this cost per inch by the length of the surface in inches. It will not be a serious amount of labor to perform this with paper and pencil. If desired, however, the rule itself can be used to perform this multiplying also, using one of its slides in a manner similar to the ordinary slide rule.

I will be glad if the readers of the AMERICAN MACHINIST will point out any errors that may exist in the principle and operation as described, and will appreciate expressions of opinion as to the probable usefulness of the instrument.

Spain's Tariff Against Emery Products

Under date of November 2, Consul-General Ridgely, of Barcelona, reports briefly on that feature of the new Spanish tariff which relates to emery wheels and emery products, and substitutes for emery, such as alundum and carborundum.

Under the old tariff, which ceased to be effective on the 30th of last June, all these products coming from the most favored nations paid 20 centimos silver (about 3 cents) per 100 kilograms (220 pounds) and 40 centimos (6 cents) when coming from the non-treaty nations. Under the tariff now in force emery wheels weighing more than 25 kilograms (55 pounds) each pay at the rate of 30 pesetas gold ($5.79) per 100 kilograms, and wheels weighing less than 25 kilograms pay 120 pesetas ($23.16) the 100 kilograms. As wheels of greater weight than 25 kilograms are very rarely used in Spain the duty on emery wheels is now practically $23.16 per 100 kilograms instead of 3 cents. In other words, the duty when paid in gold has been increased 660 times, and considering the depreciated silver currency in which it was formerly paid it has been increased 660 times. This new duty is also held to apply to alundum, carborundum, and other similar substitutes for emery.

It seems to have been determined that polish and finish shall be costly in Spain hereafter.

DIAGRAMS FOR AUTOMOBILE POWER CALCULATIONS

BY GEO. WATSON

As a designer of all types of motor vehicles I frequently have to calculate the tractive effort which might reasonably be expected with a given horse-power and gearing, and at times I require to know what horse-power will be required to take a given load up a given incline when the road resistance can be assumed within reasonable limits.

So frequently have I gone through the formulas for this that I have thought it advisable to lay out a chart for each one, thus enabling me to read any given result without any calculation. As there are many designers who are similarly situated I thought these diagrams might prove useful to many of your readers. I have frequently found many useful charts in your pages and I am sure that there are many readers who would appreciate these charts which will enable them to answer at a glance, many questions which are frequently asked in the motor engineer's drawing office.

Fig. 1 is constructed from the formula

$$B.h.p. = \frac{T\,l}{\eta\ 375},$$

or

$$T = \frac{\eta\ h.p.\ 375}{l},$$

in which

T = tractive effort.

l = velocity in miles per hour.

η = efficiency of gearing.

$$375 = \frac{60 \times 33{,}000}{5280}.$$

Note: $\eta = 0.9$ for each pair of gears in mesh is only correct for plain bearings such as phosphor bronze.

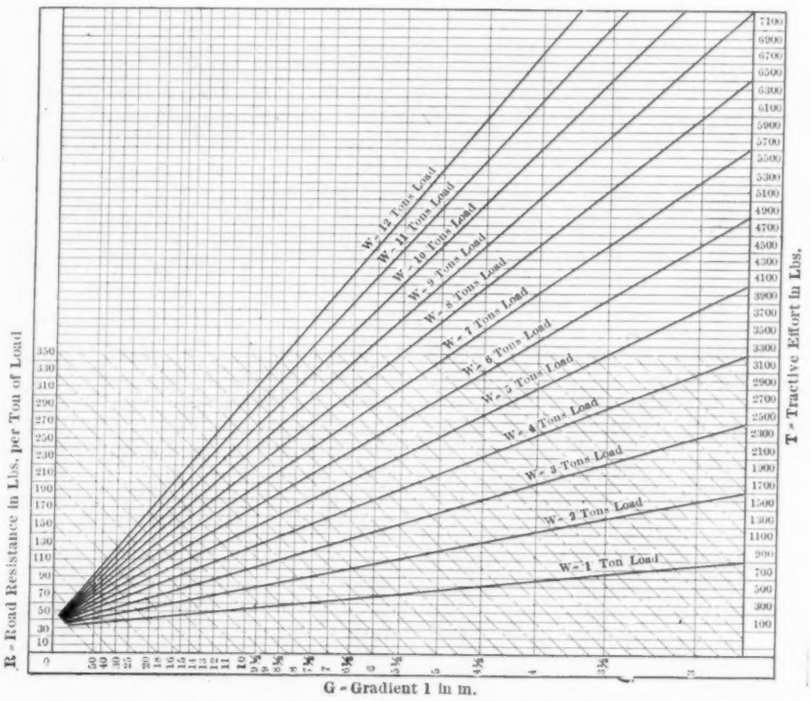

R = Road Resistance in Lbs. per Ton of Load
T = Tractive Effort in Lbs.
G = Gradient 1 in m.
W = 12 Tons Load
W = 11 Tons Load
W = 10 Tons Load
W = 9 Tons Load
W = 8 Tons Load
W = 7 Tons Load
W = 6 Tons Load
W = 5 Tons Load
W = 4 Tons Load
W = 3 Tons Load
W = 2 Tons Load
W = 1 Ton Load

FIG. 2. ROAD RESISTANCE, GRADIENT AND TRACTIVE EFFORT CHART

From 52 brake horse-power on the left of the chart trace horizontally until the diagonal line for two pairs of gears is cut. Then drop vertically until the diagonal for 7 miles per hour is cut, from this point trace horizontally to the right and read the tractive effort in the column at right of the chart = 2250 pounds.

Fig. 2 is constructed from the formula

$$T = W\left(R + \frac{2240}{m}\right),$$

in which

T = tractive effort in pounds.

W = gross weight to be moved, tons.

R = resistance to traction in pounds per ton.

m = gradient, 1 in M.

Example: Gross load = eight tons. $R = 80$ pounds. Gradient = 1 in 7. Find T. On the base line find 7 (G) and follow up the vertical until it intersects the horizontal from 80 (R) on the left; next follow the dotted diagonal line to the base and from thence read up to the point of intersection with the diagonal for eight tons (W). From this point trace to the right and the answer will be found in the right-hand column, viz: 3200 pounds.

The table gives the road resistances to be used in connection with Fig. 2.*

Railroads	10
Good Asphalt	15
Asphalt	22
Poor Asphalt	29
Tramways	30
Wood paving	30
Good setts	35
Best Macadam	43 to 46
Ordinary Macadam	50 to 60
Soft Macadam	97

*The tons are of 2240 pounds.—ED.

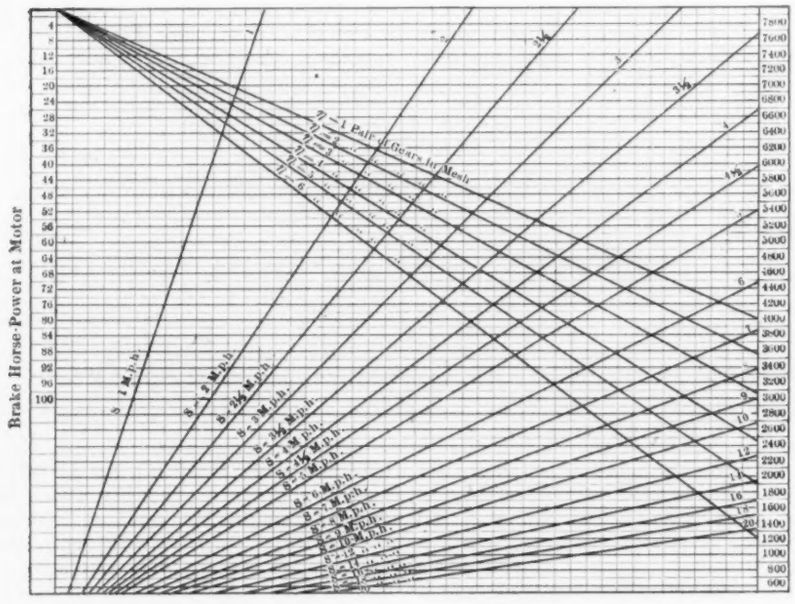


FIG. 1. BRAKE HORSE-POWER AND TRACTIVE EFFORT CHART

Take 0.9 for each gear; then $\eta = 0.9^x$ where x = the number of gears in mesh. 375 = number of mile pounds per hour per horse-power.

Example: With an engine of 52 brake horse-power driving a vehicle at 7 miles per hour through two pairs of gears, what will be the tractive effort at the driving wheel?

Best gravel	57
Cobbles	60
Ordinary cobbles	130
Very bad cobbles	240
Best clay	110
Hard, dry clay	100
Sand road	360
Loose sand	560

TABLE OF ROAD RESISTANCES.
Basingstoke, England.

Solid Keys

BY J. J. SIEBERT

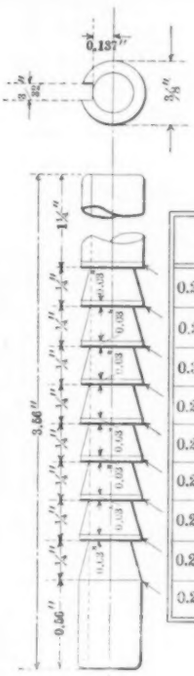
Judging from the trouble we had when we first endeavored to make solid keys, I have no doubt it will interest many to know our solution of the problem and it may save a few the same troubles.

The keys of the worms, gears, worm-wheels, etc., of all of the latest type of sight for the naval guns are made with a solid key, which allows for a smaller diameter of work and gives a strong accurate key, without lost motion. The absence of the latter is essential to a perfect sight.

A SET OF BROACHES

Fig. 1 shows a complete set of broaches for making the key of a steel worm of rather coarse pitch, 5/8 inch diameter, 3/8 inch bore and 3/4 inch long. The key is 3/32 × 0.07 inch. It is possible to cut the key in this worm in twelve minutes with this set of broaches—less time than the ordinary key could be fitted in, to say nothing of machining the keyway and key.

The notches shown in the cutting edges are all ground in after they are finished and are for breaking up the chips. The work to be operated on is rough turned to a common diameter for locating under the press. The hole is bored the finished diameter less twice the depth of the key, which in this case gives a hole 0.274 inch diameter to start with. This is the diameter of broach No. 1, Fig. 1, at the small end. This end is entered in the hole and acts as a pilot for the broach, which is passed through the work at about 1 foot a minute. The shanks of the broaches are relieved so that they will drop out when the last cutting edge is through the work, and allow the entry of broach No. 2, and so on until all the broaches have been used.



Allow 0.001 for Grinding

1	2	3	4	5	6	7	8	9	10	11
0.2845	0.295	0.3055	0.316	0.3265	0.337	0.3475	0.358	0.367	0.373	0.375
0.2845	0.295	0.3055	0.316	0.3265	0.337	0.3475	0.358	0.367	0.373	0.375
0.283	0.2935	0.304	0.3145	0.325	0.3355	0.346	0.3565	0.366	0.3725	0.3749
0.2815	0.292	0.3025	0.313	0.3235	0.334	0.3445	0.355	0.365	0.372	0.3747
0.280	0.2905	0.301	0.3115	0.322	0.3325	0.343	0.3534	0.364	0.371	0.3745
0.2785	0.289	0.2995	0.310	0.3205	0.331	0.3415	0.352	0.3625	0.370	0.3743
0.277	0.2875	0.298	0.307	0.319	0.3295	0.340	0.3509	0.361	0.369	0.374
0.2755	0.286	0.2965	0.301	0.3175	0.328	0.3385	0.349	0.3595	0.368	0.3735
0.274	0.2845	0.295	0.3055	0.316	0.3265	0.337	0.3475	0.358	0.367	0.373

FIG. 2. PROPORTIONS OF BROACHES FOR A MACHINE STEEL WORM WITH A BORE OF 3/8-INCH DIAMETER AND 3/4-INCH LENGTH

PROPORTIONS OF THE BROACHES

Fig. 2 gives a table that was gotten up in the shop for use in making the broaches. It will be noticed that the pilot of each broach has the same diameter as the largest diameter of the preceding one and while the first broach takes a cut of 0.0105 inch, the last one takes a cut of only 0.0020 inch. The reason for this is that the light cuts at the finish of the operation give a smoother hole than a uniform cut would give. In making the broaches, ordinary tool steel was used at first and while we did get a set occasionally by allowing plenty for grinding and making new ones in place of those spoiled in the tempering, the result was far from satisfactory.

SELF-HARDENING STEEL USED

The broaches are made from self-hardening steel, and air tempered. An allowance of 0.001 inch is sufficient for grinding. Broaches of this steel work perfectly.

It was found that length made a difference in the depth of the cut that could be taken and that the broaches made for a thin piece would shake up and break when used on thicker work. This difficulty was overcome by decreasing the depth of cut and increasing the number of broaches. We have made keys in a 3/4-inch hole, 3 inches long, the keys being 3/16 inch wide and no doubt larger bores can be worked. Fig. 3 shows a few samples of the work.

A heavier cut can be taken in bronze than in steel. In working bronze it was found necessary to have the finishing broach 0.002 inch larger than the desired

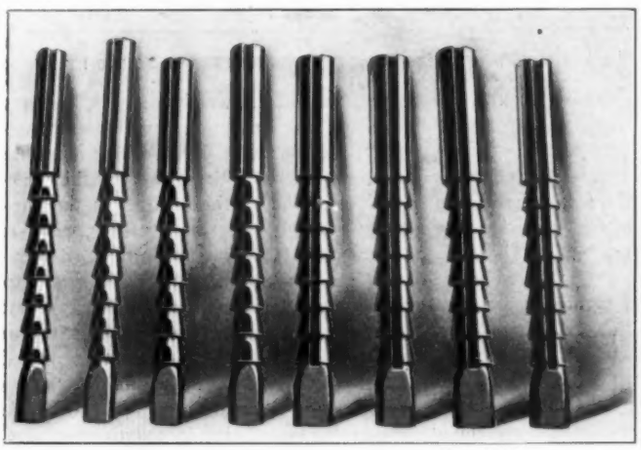


FIG. 1. A COMPLETE SET OF BROACHES

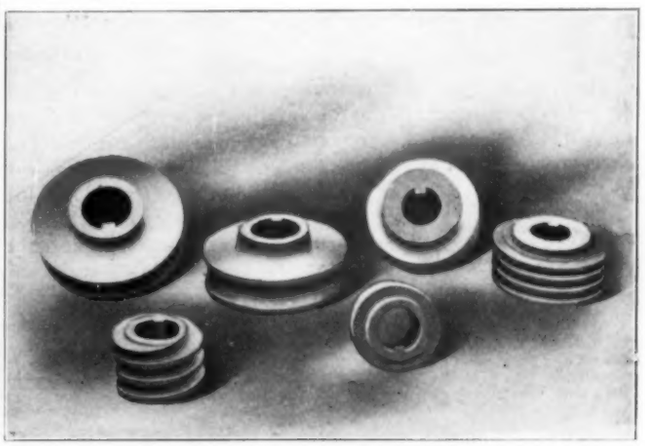


FIG. 3. SAMPLES OF WORK

size. It has been found that the more steps and the less depth of cut the broaches are given, the better they will work. When the broaches have not been asked to do too much the finished bore is smooth and beautiful and the finished work all that could be desired.

Notes on Wire Springs, with Table of Loads and Deflections

BY F. D. HOWE

Springs stand up and do their work under higher fiber stress than would be practicable in any other element of our machines, but there is a limit even for a spring; and when the load exceeds that limit, and the spring, after a short life of chronic overload, finally breaks, we make a few remarks about the unreliability of springs, and wind up another of one gage larger wire and try it. Some day, when it becomes generally known that a broken spring means a black eye for the designer, the material or the maker, quite as much if not more than in a case of broken crank-shaft, cylinder or other machine part, there will be demand enough for high-grade material to induce manufacturers to give us wire of chrome-nickel or vanadium steels. Then those places where limitations of space make it impossible to get in a properly designed spring will not be so numerous, for the work which can be stored in a spring varies as the square of the fiber stress in the material.

Spring design in every case involves the determination of two factors; strength or weight-carrying ability, and flexibility, and often, in case of compression springs, stability. So many variables enter into the problem that the selection of the best proportions to suit a given set of conditions is a somewhat tedious task, unless the trail has been blazed by trial of various springs or previous calculations can be referred to. A table of loads and deflections for various springs, such as that given in Kent,* is of great assistance in the work, but unfortunately, Kent's table does not cover the range of sizes most used in automobile and similar work. The accompanying table is intended to fill the gap. It is based on the same stress of 60,000 pounds used in Kent's table, and the wire gage used is Roebling's or Washburn-Moen,† which is that used by some of the best spring makers.

With the materials ordinarily available, 60,000 pounds is too high a working stress for a constantly working spring, but may be used where the work is intermittent. A set of valve springs in which the stress reaches 50,000 pounds, has been in use for some time in an automobile engine without failing, but that is probably about as high a stress as is safe for such rapid and continuous work.

The weight of a square wire spring to absorb a given amount of work is 50 per cent. greater than that of a round wire one. It will carry a heavier load with given dimensions, but its flexibility will be much less.

Compression springs are bad enough, but the man who has to design an extension spring to go into a limited space has my sympathy. He is very apt to find that to get the required strength and flexibility within the limits of length and diameter available, he needs so many coils that it is a physical impossibility to get them in. Like the Cheshire cat which Alice saw in Wonderland, the spring must evolve itself out of nothing as it expands, returning into nothingness, leaving only the "grin" of the end loops. The spring maker can help him somewhat by winding the spring with initial tension but there is a limit to this aid, which often leaves him still short of the desired spring capacity. The only way out of the difficulty is to make more room or find a material which will bear a higher stress.

No. 28, .016"	D	.20	.25	.3125	.375	.4375	.500	.5625	.625	.75	.875	1.00
	W	.524	.41	.31	.27	.23	.20	.175	.16	.13	.11	.098
	F	.0758	.1563	.366	.564	.914	1.380	1.99	2.76	4.83	7.74	11.3
		.0632	.1302	.302	.470	.760	1.150	1.66	2.30	4.02	6.95	9.42
		.0542	.1117	.262	.402	.652	.986	1.44	1.97	3.45	5.52	8.07
No. 24, .0225"	D	.25	.3125	.375	.4375	.500	.5625	.625	.75	.875	.100	1.125
	W	1.18	.92	.76	.45	.56	.50	.45	.37	.31	.28	.24
	F	.0334	.0757	.1365	.2225	.338	.490	.682	1.468	1.952	2.91	4.16
		.0278	.0631	.1135	.1857	.282	.408	.569	.975	1.660	2.42	3.46
		.0238	.0541	.0974	.1580	.242	.350	.488	.835	1.395	2.08	2.97
No. 22, .028"	D	.25	.3125	.375	.4375	.50	.5625	.625	.75	.815	1.00	1.125
	W	2.35	1.84	1.49	1.26	1.095	.96	.865	.715	.61	.53	.47
	F	.01425	.0299	.0543	.0891	.1368	.198	.277	.489	.798	1.193	1.78
		.0119	.0250	.0453	.0742	.1140	.165	.231	.408	.660	.995	1.42
		.0102	.0214	.0388	.0637	.0977	.142	.198	.350	.565	.802	1.22
No. 20, .035"	D	.25	.3125	.375	.4375	.50	.5625	.625	.75	.875	1.00	1.125
	W	4.7	3.64	2.97	2.5	2.18	1.92	1.72	1.42	1.20	1.05	.93
	F	.00541	.0114	.0210	.0348	.0537	.0782	.1098	.195	.317	.480	.690
		.00451	.00952	.0175	.0290	.0447	.0651	.0914	.163	.264	.400	.575
		.00386	.00815	.0150	.0249	.0384	.0558	.0784	.1895	.226	.343	.493
No. 19, .041"	D	.25	.3125	.375	.4375	.50	.5625	.625	.75	.875	1.00	1.125
	W	7.875	6.05	4.98	4.15	3.58	3.16	2.82	2.32	1.975	1.74	1.54
	F	.00280	.00565	.01055	.01685	.0274	.0400	.0564	.1010	.1645	.250	.361
		.00234	.00471	.00880	.01060	.0228	.0334	.0410	.0842	.1370	.208	.305
		.00200	.00403	.00754	.00907	.0196	.0286	.0403	.0722	.1175	.177	.258
No. 18, .047"	D	.25	.3125	.375	.4375	.50	.625	.75	.875	1.00	1.125	1.25
	W	12.05	9.2	74.5	6.57	5.40	4.23	3.48	2.95	2.85	2.27	2.02
	F	.001388	.00352	.00585	.00968	.01585	.02205	.0476	.4943	.1475	.210	.290
		.001158	.00294	.00488	.00824	.01320	.01870	.0396	.0785	.1260	.175	.242
		.000990	.00251	.00418	.00706	.01131	.01575	.0340	.0673	.1055	.150	.207
No. 17, .054"	D	.25	.3125	.375	.5	.625	.75	.875	1.00	1.125	1.25	1.50
	W	18.9	14.3	11.5	8.30	6.47	5.32	4.5	3.91	3.45	3.10	2.56
	F	.000715	.00166	.00314	.00842	.0177	.0320	.0525	.0804	.1165	.1802	.275
		.000596	.00138	.00256	.00702	.0145	.0267	.04375	.0670	.0971	.1502	.228
		.000510	.00118	.00224	.00602	.0126	.0228	.0375	.0575	.0832	.1290	.196

TABLE OF CARRYING CAPACITY AND DEFLECTION OF HELICAL SPRINGS OF ROUND STEEL

$$W = 0.3927 \frac{S d^3}{D - d} \quad \text{For round steel.}$$

$$F = 8 \frac{P (D - d)^3}{E d^4} \quad \text{For round steel.}$$

$$W = 0.471 \frac{S d^3}{D - d} \quad \text{For square steel.}$$

$$F = 4.712 \frac{P (D - d)^3}{E d^4} \quad \text{For square steel.}$$

D = outside diameter of spring.
W = load carried in pounds.
F = deflection of one coil.
d = diameter of wire.
S = fiber stress of material.
E = torsional modulus of elasticity.

Loads given in table are based upon 60,000 pounds stress. For continuous work use lower stress. For brass wire use 10,000 to 20,000 pounds. For square steel multiply W by 1.2. F is calculated upon modulus of torsional elasticity of 10, 12 and 14 millions, and it is the deflection of one coil under 1 pound load. For brass wire use double the figure for 12 million modulus. For square steel multiply F by 0.59.—*The Horseless Age.*

Results of an Investigation into the Use of High Steam Pressures

The demand by the transportation department of our railroads for more powerful locomotives to handle trains, which are continually increasing in weight, leads to the increase by the civil-engineering department in the weight of rails, bridges, etc., and the adoption by the motive-power department of every possible means to increase the power of the locomotives. One of these latter is the carrying of higher steam pressures, until it appears that the practicable limit of pressure has about been reached. In order to throw some light upon this subject, about three years ago the Carnegie Institution of Washington, D. C., became a patron of Purdue University, in promoting a research to determine the value of high steam pressure in locomotive service. This work has been completed, and a report made, which gives some interesting conclusions, as set forth in a paper by Prof. W. F. M. Goss, read before the Western Railway Club.

The tests were made upon the Purdue locomotive, known as "Schenectady No. 2," and included 100 tests aggregating runs of 14,072 miles. The pressures ranged from 120 pounds to 240 pounds per square inch. As a result of these tests Dr. Goss

*Which was taken from the AMERICAN MACHINIST, Vol. 15, August 18, 1892, page 2.—ED.

†In the AMERICAN MACHINIST—Kent table, the gage employed, below ¼ inch, was the Birmingham Wire Gage.—ED.

has apparently not formed a very high opinion of the advantages of exceedingly high pressures.

In the first place, the water supplied to locomotives cannot, on the average, be called pure, and in this case the water supply of the laboratory contains a considerable amount of magnesia and carbonate of lime, and much trouble was found with scale deposits, so that often, at the highest pressures, the injectors would fail after two hours on account of deposits in the check valves, the delivery tubes, etc. It, therefore, became necessary to use as a source of water supply the return tank of the university's heating plant. With Purdue's previous locomotive, which was run at a pressure of 130 pounds, no trouble whatever was experienced from this source. With the high pressure another difficulty was the attention required by the boiler in the way of keeping it tight and making repairs.

The tests developed no serious difficulties in the lubrication of valves and pistons under pressures as high as 240 pounds, though the lubrication could not be done with the grade of oil previously employed. It was shown that the evaporative efficiency of a locomotive boiler is but slightly affected by changes in pressure between the limits of 120 and 240 pounds.

The steam consumption under normal conditions of running with a pressure of 120 pounds was 29.1 pounds of steam per horse-power hour; at 140 pounds was 27.7; at 160 pounds, 26.6; at 180 pounds, 26.0; at 200 pounds pressure it was 25.5 pounds per horse-power hour; at 220 pounds, it was 25.1; and at 240 pounds, 24.7 pounds of steam per horse-power hour.

It was shown that the higher the pressure, the smaller the possible gain resulting from a given increment of pressure. An increase of pressure from 160 to 200 pounds results in a saving of 1.1 pounds of steam per horse-power hour, while a similar change from 200 pounds to 240 pounds improves the performance only to the extent of 0.8 of a pound per horse-power hour.

The coal consumption at 120 pounds was 3.84 pounds of coal per horse-power hour; at 140 pounds was 3.67; at 180, 3.46; at 200, 3.40; at 240 pounds, 3.31 pounds of coal, from which it is seen that an increase of pressure from 160 to 200 pounds results in a saving of 0.13 pound of coal per horse-power hour, while a similar change from 200 to 240 results in a saving of but 0.09 pound.

Not only does a locomotive carrying a very high pressure demand more expense for maintenance, but it is necessary that it be maintained in a first-class condition if the economy from the use of the high pressure is to be realized. This maintenance applies not only to the boiler, but to the engine itself. Wherever there is a chance for a leak, such, for instance, as at the packing of the piston and valve rods, and in fact wherever there is a joint, there will be found a leakage unless extraordinary efforts are used in taking care of these places. It was in fact found necessary to throw out a great many tests in making up the records because of the amount of water lost by such leakage.

Professor Goss concludes that a given

TABLE OF HELICAL SPRINGS—CONTINUED

No. 16 .063"	D	.25	.375	.50	.625	.75	.875	1.00	1.125	1.25	1.50	1.75
	W	31.5	18.8	13.8	10.5	8.57	7.25	6.28	5.04	4.96	4.10	3.50
	F	.000312	.00145	.00372	.00846	.0155	.0280	.0393	.0572	.0797	.1417	.228
	F	.000260	.00122	.00310	.00704	.0129	.0233	.0327	.0476	.0660	.1180	.190
	F	.000223	.00107	.00266	.00609	.0111	.0200	.0281	.0408	.0566	.1010	.163
No. 15, .072"	D	.375	.5	.625	.75	.875	100	1.125	1.25	1.50	1.75	2.00
	W	29.0	20.5	15.85	12.92	10.9	9.46	8.35	7.45	6.15	5.25	4.53
	F	.000798	.00225	.00485	.00893	.01487	.02275	.0335	.0468	.0635	.1355	.245
	F	.000665	.00185	.00404	.00744	.01240	.01895	.0279	.0390	.0697	.1160	.204
	F	.000570	.00159	.00396	.00638	.01061	.01650	.0239	.0335	.0597	.0968	.175
No. 14, .08"	D	.375	.5	.625	.75	.875	1.00	1.125	1.25	1.50	1.75	2.00
	W	41	28.8	22.2	18.1	15.2	13.15	11.6	10.35	8.52	7.25	6.3
	F	.000501	.00149	.00411	.00687	.0098	.0152	.0223	.03125	.0658	.0908	.139
	F	.000418	.00128	.00342	.00572	.0082	.0127	.0186	.0260	.0548	.0757	.116
	F	.000358	.00106	.00293	.00490	.0070	.0108	.0159	.0223	.0471	.0650	.099
No. 13, .092"	D	.5	.625	.75	.875	1.00	1.25	1.50	1.75	2.00	2.30	2.50
	W	45.7	35	28.4	23.8	20.3	16.1	13.15	11.25	9.72	8.65	7.75
	F	.00076	.001688	.00319	.0054	.00865	.01775	.0319	.0510	.0790	.112	.157
	F	.000634	.001410	.00266	.0045	.00721	.01480	.0266	.0425	.0658	.080	.131
	F	.000543	.001210	.00228	.00386	.00618	.01270	.0228	.0364	.0564	.093	.112
No. 12, .105"	D	.625	.75	.875	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75
	W	52.5	42.25	35.4	30.4	2.38	19.5	16.6	14.4	12.7	11.4	10.3
	F	.000927	.001772	.00315	.00473	.00995	0179	.0294	.0448	.0653	.0880	.123
	F	.000800	.001480	.00262	.00395	.00830	.0149	.0245	.0374	.0545	.0734	.102
	F	.000690	.001270	.00215	.00338	.00710	.0128	.0210	.0320	.0467	.0630	.086
No. 11, .120"	D	.75	.875	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00
	W	65	54	46	36	29	25	22	19	17	15.5	14
	F	.000937	.00161	.00256	.00541	.00985	.01624	.0249	.0362	.0505	.0682	.092
	F	.000804	.00134	.00219	.00464	.00845	.01392	.0213	.0311	.0433	.0568	.077
	F	.000670	.00114	.00182	.00386	.00704	.01160	.0178	.0259	.0361	.0486	.066
No. 10, .135"	D	.875	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25
	W	77	67	52	42.5	36	31	27	24	22	20	18.5
	F	.00097	.00162	.00332	.00614	.01015	.01565	.02285	.03195	.0428	.0570	.0730
	F	.00081	.00135	.00276	.00512	.00846	.01295	.01910	.02660	.0358	.0475	.0606
	F	.00069	.00116	.00237	.00438	.00725	.01110	.01662	.02280	.0306	.0407	.0522
No. 9, .148"	D	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50
	W	90	69.5	5.65	47.5	41.2	38	32.5	29.4	26.8	24.6	22.8
	F	.00103	.003195	.00412	.00682	.0094	.0157	.0216	.0288	.0376	.0496	.0626
	F	.000858	.001962	.00317	.00568	.00785	.0131	.0180	.0240	.0313	.0413	.0522
	F	.000737	.001682	.00274	.00487	.00671	.0112	.0154	.0206	.0269	.0354	.0447
No. 8, .162"	D	1.00	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50
	W	120	98.5	76	64	55.5	48.8	43.5	39	36	33	30.5
	F	.000684	.00150	.00238	.00665	.00718	.01055	.0147	.0202	.0264	0342	.0437
	F	.000570	.00124	.00199	.00554	.00597	.00880	.0126	.0168	.0220	.0285	.0364
	F	.000488	.00107	.00170	.00475	.00513	.00754	.0105	.0144	.0188	.0244	.0312
No. 7, .177"	D	1.00	1.25	1.50	1.75	2.50	2.25	2.50	2.75	3.00	3.25	3.50
	W	159	122	99	83.5	72	63	56.4	51	46.5	42.5	39.5
	F	.00046	.000992	.001875	.00318	.00499	.00724	.00995	.0138	.0186	.0236	.0299
	F	.000382	.000828	.00156	.00265	.00416	.00602	.00830	.0115	.0154	.0196	.0249
	F	.000328	.000710	.00134	.00227	.00356	.00517	.00710	.0099	.0135	.0168	.0214
No. 6, .192"	D	1.25	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00
	W	158	128	107	925	81	72	65	59.5	55.5	50	44
	F	.000686	.00130	.00219	.00342	.00504	.00709	.00965	.0128	.0165	.0209	.0320
	F	.000572	.00108	.00185	.00284	.00420	.00590	.00802	.0107	.0138	.0174	.0266
	F	.000490	.00093	.00156	.00244	.00360	.00506	.00688	.0091	.0118	.0149	.0228
No. 5, .205"	D	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50
	W	155	131	113	99	88.5	80	70	67	61.5	53.5	47.3
	F	.000985	.00167	.00262	.00385	.0049o	.00742	.00988	.0125	.0161	.0245	.0356
	F	.000820	.00139	.00218	.00321	.00412	.006175	.0082	.0160	.0134	.0222	.0298
	F	.000706	.00119	.001875	.00275	.00353	.0053	.00702	.0091	.0115	.0175	.0278
No. 4, .225"	D	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50
	W	210	175	150	132	118	106	97	89	82	71	63
	F	.000643	.00111	.00177	.00264	.00364	.00497	.00662	.00887	.0109	.0156	.0242
	F	.000536	.00093	.00147	.00220	.00303	.00412	.00552	.00715	.0091	.0130	.0202
	F	.000459	.00079	.00126	.001885	.00260	.00354	.00473	.00613	.0078	.0111	.0176
No. 3, .224"	D	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50
	W	250	225	195	170	152	136	125	114	105	88	80
	F	.000452	.000618	.000975	.00144	.00238	.00356	.00472	.00623	.00780	.01035	.0139
	F	.000376	.000515	.000813	.00120	.00198	.00297	.00391	.00510	.00650	.00864	.0116
	F	.000323	.000441	.000696	.00103	.00170	.00255	.00337	.00437	.00557	.00740	.0099
No. 2, .263"	D	1.50	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50
	W	345	290	250	215	192	175	156	146	134	115	100
	F	.000317	.000550	.000876	.00131	.00185	.0025/	.00341	.00445	.00563	.00866	.0127
	F	.000264	.000458	.000730	.00109	.00154	.00214	.00274	.00371	.00469	.00720	.0106
	F	.000226	.000393	.000625	.00094	.00132	.00187	.00244	.00318	.00402	.00620	.0091
No. 1, .283"	D	1.75	2:00	2.25	2.50	2.75	3.50	3.25	3.50	4.00	4.50	5.00
	W	360	310	270	240	215	195	180	165	145	127	113
	F	.000394	.000661	.000946	.00134	.00187	.00249	.00324	.00412	.00636	.00930	.00154
	F	.000328	.000550	.000778	.00112	.00155	.00208	.00270	.00344	.00530	.00775	.00128
	F	.000281	.000472	.000675	.00096	.00133	.00178	.00231	.00294	.00455	.00665	.00110
No. 0, .307"	D	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50	5.00
	W	470	400	350	310	280	250	230	212	185	162	145
	F	.000370	.000436	.000658	.000945	.001305	.00179	.00239	.00293	.00452	.00662	.00925
	F	.000306	.000380	.000548	.000788	.00109	.00149	.00199	.00244	.00327	.00550	.00770
	F	.000257	.000326	.000470	.000675	.00093	00128	.00171	.00209	.00323	.00472	.00660
No. 00, .331"	D	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50	5.00	5.50
	W	510	445	390	350	320	290	270	230	205	183	165
	F	.000347	.000467	.000677	.000938	.00126	00164	.00211	.00327	.00496	.00673	.00901
	F	.000289	.000388	.000564	.000780	.00105	.00137	.00176	.00273	.00414	.00562	.00750
	F	.000248	.000334	.000483	.000670	.00090	.00117	.00151	.00234	.00372	.00481	.00643
No. 000, .362"	D	2.00	2.25	2.50	2.75	3.00	3.25	3.50	4.00	4.50	5.00	5.50
	W	700	610	540	480	425	400	365	315	280	250	225
	F	.000123	.000189	.000275	.000385	.000515	.000677	.000867	.00135	.00199	.00280	.00383
	F	.000102	.000158	.000229	.000320	.000739	000563	.000722	.00113	.00166	.00234	.00319
	F	.000088	.000135	.000196	.000275	.000368	.000484	.000620	.000467	.00142	.00200	.00273

increase in weight of a locomotive in order to obtain increased power would be much better applied to the construction of a larger boiler, having greater capacity, rather than to the making of a stronger boiler capable of carrying a higher pressure, assuming that in the former case the boiler is made capable of carrying a pressure of about 180 pounds, which he considers to be shown, by these tests on a single-expansion locomotive, using saturated steam and running with a wide-open throttle, to be a good standard where the maintenance is of a high order. Where the maintenance is not of the highest grade, the standard running pressure should be lower, which is also the case where water containing foaming or scale-making matter must be used in the boiler. A simple locomotive using saturated steam will render good and efficient service when the running pressure is as low as 160 pounds; under most favorable conditions, no argument is to be found in the economical performance of a machine which can justify the use of pressures greater than 200 pounds.

The Conditions of Fan-blower Design

In the publication of the article under the above heading, at page 634, we regret that the value of the constant x in the formula was omitted. For approximate figuring with ordinary types of fans the value 3 may be used; in refined practice it will vary with the proportions of the fan, or if this value be employed for all basic calculations, a coefficient may be introduced according to the individual type of fan, as indicated by the experience of the engineer, his intimate acquaintance with the conditions, and his ability to estimate the effect of resistance in reducing the free discharge area to the equivalent of the capacity area.

World's Fair at Seattle in 1909

The Alaska-Yukon-Pacific Exposition to be held at Seattle in 1909 will not celebrate any particular event, but is primarily to exploit the resources of Alaska-Yukon and the Pacific Northwest and make known the importance of the trade of the Pacific Ocean and the countries bordering upon it. The site comprises 255 acres of the Washington University campus and some of the exhibition buildings will be erected as permanent structures which will remain as the property of the University after the fair closes, to be used for educational purposes. It is estimated that the exposition will cost $10,000,000.

The War department has selected a site in Dover, N. J., for the Government powder factory, for which Congress appropriated $165,000 the last session.

QUICK DRAFTING

The Universal Use of the Full Size Scale for Part Size Drawings Advocated

BY CHARLES PRESCOTT FULLER

From time to time the subject of drafting is discussed in technical journals, and rightly, for the drafting department is in most, and should be in all modern establishments, the brain of a mechanical-engineering works, and any method of drafting tending to the more accurate and at the same time more expeditious execution of working drawings of mechanism can best prove of value not only in the drafting room itself, but collaterally in every department of the works where introduced.

DRAFTSMENS' METHODS

One finds on record endless systems of arrangements for working and detailed drawings, of checking and keeping track of them in the workshops and elsewhere, but one sees very few attempts on record to improve the methods of the draftsman, upon whom, after all is said and done, the responsibility of executing designs rests, and it is the hope of arousing interest to this end that the following method is explained.

We all know that draftsmen differ in the facility with which they accomplish their work, but the majority work in a more or less laborious manner, and possibly the following method may prove the means, if mastered, of enabling such to not only increase their own efficiency but also to increase their salaries.

It is quite possible, indeed highly probable, that many draftsmen, especially in America, do work in the manner to be described; if so, however, it is strange that one nowhere sees the method mentioned or described at length; indeed, it can scarcely be in general use, or one would see less discussion over scaling instruments, the majority of which, for *mechanical* design at any rate, should be relegated to a museum of antiquities.

NATURAL SCALES

The method is rational and simplicity itself, and may be divided, for explanation, into two parts: First, the selection of natural scales, relative to the full size of the machine or mechanism to be designed; and, secondly, the application and manipulation of these scales at the hands of the designer.

In the first place the system is based on the duodecimal or foot and inch system of measurement, with the use of an ordinary foot and inch rule instead of all manner of wretched, time-wasting scaling instruments, made to sell and to fool draftsmen into wasting their own and their employer's time. The system so based will also once more prove the superiority of the duodecimal system over the decimal or metric system, for designing and measuring mechanical work to scales below full or half size, owing to absence of calculation or special instruments other than an ordinary rule.

Working by the duodecimal, foot and inch system, almost every sensible draftsman to-day designs machinery to ¼, ⅛, 1/16 or 1/32 of full size, that is, to scales of 3, 1½, ¾ or ⅜ inch to a foot. Naturally there is nothing new about that, but let us go a step further and see what these scales denote, what they really are, and how they lend themselves to the second or manipulatory part of the system under view.

The first point of importance concerning these scales is that the designs made to them can be measured with absolute accuracy on any ordinary well made foot and inch rule, as they are all a natural and definite part thereof, which by work laid down to a metric scale is not the case *without calculation*, as anyone having to scale such, where the scale is 1/5 or 1/10 or any other multiple of the meter will find out, when he gets dimensions like 1967 mm. and so on, it being a practical impossibility to draw such a dimension *accurately* to any decent scale, without calculation and a microscope, and if one cannot draw to scale accurately then it's precious little use drawing at all.

It has been said that the above mentioned duodecimal scales are a *natural* multiple of a common foot rule. This term is used advisedly, for each of them, taken as a unit representing one foot, contains natural divisions of 12 parts representing inches, found on any ordinary foot rule, not involving one single special figure otherwise than on such rules for measuring full size, and with absolutely no calculations, by multiplication or division, or other mental gymnastics, in their use, when measuring with an ordinary foot rule.

THE USE OF SCALES

In practice it will be found by any draftsman who makes up his mind that there is something to his advantage in this, that he automatically gets to working only by *units* instead of dividing and multiplying; this becomes a sort of instinct. Take the four usual scales, as in the illustration. Supposing it is required to draw a circle of 12 inches, or one foot, diameter, it is not necessary to think of six inches. The draftsman simply lays off his radius 1 foot to 1½ inch scale. Does he require 3-inch measurement, he puts down 1 foot to ¾ inch scale. If he requires to halve this again, automatically he sets his instrument to 1 foot by the ⅜ inch scale. In all these operations his mind

instinctively thinks of the unit 1. In subdividing, the same applies and with use it is marvelous what little mental effort designing to these scales in the above manner involves. The diagram is given as an aid only to comprehension of the idea given, for the mental process in so working is so subtle that it is practically an impossibility to lucidly describe it otherwise than as an acquired instinct.

DRAWING A DESIGN TO SCALE

Bearing the foregoing in mind we come to the second or manipulatory part of the method, the actual drawing of a design to scale.

For general use an ordinary 6-inch steel rule, with clearly cut divisions, is the handiest instrument to use for scaling, the old-fashioned hieroglyphic boxwood scales being for once and all discarded. A longer rule for wide dimensions is occasionally useful, but for ordinary quick working the 6-inch is the thing. Say one is working to a scale of ¼ full size or 3 inches to the foot. If a dimension is needed from a horizontal line, say 9 inches below it, the 6-inch rule is laid on the drawing with its square end bearing against the T square. Slide the T square and rule down together till the 9-inch = 2¼-inch division coincides with the line from which measurement is being taken. Flick the rule slightly upward with the fingers and draw the line by the T square, and it will be right there where needed; no need to check it, it is a correct measurement once for all. If it is needed to draw a line *above* a given horizontal line, put the T square to this, bring back the 6-inch rule end to the T square, put the pencil point to the needed dimension on the rule and slide up both rule and T square until the latter touches pencil point, draw the needed line and it will be again correct, where needed and may be left to take care of itself; there need be no checking. For measurements from vertical lines the same method is adopted in conjunction with set and T squares. The main thing is here that there is no two-handed work for scaling, the pencil need never be laid down, unless to pick up one's compass for circling or some similar instrument.

Any practical draftsman who values his time and who will condescend to master the whole method of thus working will soon find he can do 100 per cent. more work than by any other method.

The Universal Drafting Machine Company's instrument is a practical embodiment of this method of manipulation, and where an ordinarily marked rule is substituted for the usual scales, is the smartest thing yet invented for quick work at the drawing board.

THE FLAT VS. THE VERTICAL BOARD

For speed and accuracy nothing is better than a board approximately flat, tipped at the back just sufficient that instruments are not an everlasting nuisance through slipping down; vertical boards with pulley and counter-balance rigs are a special device for increasing the staff in drafting rooms, by limiting the output; there is no possibility of getting speed in designing, to say nothing of accuracy, on one of these abominations.

AVOIDING COPYING

While on the subject of machine design there are two points still much neglected. One is the avoidance of copying what others have done, and the other is the use of perspective sketches of a piece of mechanism or entire machine just as the designer has it *as finished* in his mind's eye, before he commences his design on paper for working to. In copying slavishly what has been previously done, one gets the benefit of all the mistakes that may later show up. It's cheap, this copying—deuced cheap—but how many beginners have had their prospects set back months or years through it? Adaptation of certain fixed points, the outcome of the world's experience in any line of machinery, is clearly admissible, but how few are the designers that, granted these points, are capable of creating really new and more advantageous complete arrangements of mechanism as a whole around such standard points. Still fewer are the draftsmen who can get the whole view of their complete machine in their eye before starting their working drawings and put that view into two or three all-embracing perspective sketches. Where this is the case it is possible to design complicated machines with scarcely a touch of the eraser on a working drawing; the parts seem to work themselves out and come together with no mental effort, and there is no doubt but that there are a number of machine draftsmen who are capable of so working, and who owe their responsible positions to this one fact. Few in number they may be, but they undoubtedly are there; if the *majority* would try and work on the lines given in the first part of this article and try to abolish laborious calculation in connection with silly scaling instruments which have had their day, undoubtedly we should see and hear more of the first-class designer in the future, whose emoluments would be higher, whose employers would be more satisfied, and the mechanical-engineering profession generally the benefiter thereby.

The new steamship "Charcas" arrived recently from Newcastle, England, by way of Savannah. She was built on the Tyne for the New York-Pacific service of William R. Grace & Co., by the Sir William G. Armstrong-Whitworth Company, Limited. Her dimensions are: Length, 417 feet; depth, 31 feet, and beam, 52 feet. She has double cellular bottom tanks for carrying of oil for fuel. She can carry 8,200 tons of cargo and has twenty derricks. The vessel is fitted with all modern appliances, including electric lights, a fire-extinguishing plant, and a fumigating plant.

Legal Notes

BY E. P. BUFFET

CONTRACT FOR SALE OF MILL—IMPLIED WARRANTY—DAMAGES FOR BREACH OF WARRANTY

A gold-mining company of Oregon was sued by a concern dealing in mining machinery for the unpaid balance of purchase price of a Huntington mill. The mining company sought to set off against the contract price damages sustained by breach of contract, it being alleged that the mill was imperfectly constructed and that it was not the "latest improved" Huntington mill called for in the contract. In the circuit court the defendant (mining company) obtained judgment, but on appeal the Supreme Court has ordered a new trial. In discussing the principles of law applicable to the case the chief justice brings up the following points of interest.

The case, as here presented, is one in which a known and described article was ordered, and there was no implied warranty as to its appropriateness for a special use, although the seller may have been advised that it was intended for such a purpose. There was, however, an implied warranty that it would conform to the description. If it differed from the terms of agreement by being an old-style mill rather than the "latest improved" model, the seller should be answerable in damages for this breach and the fact that the mining company made an effort to use the mill was not a waiver of its right to damages.

While the ordinary rule as to amount of damages in cases of this kind is the difference in value of the goods ordered and those furnished and accepted, there may be special circumstances which will enhance the sum. Thus, if it was known to the sellers that the mill was intended for a particular purpose they will be liable for damages resulting directly and proximately from breach of the contract. In a case of this nature they might be accountable for expenses and labor incurred in testing the mill; freight paid on imperfect parts furnished, but unusable by the mining company; cost of providing new parts necessary to make the mill conform to contract, if the seller refused or neglected to supply them; wages paid the mine crew while idle on account of the defective mill, etc.
86 Pac. Rep., 789.

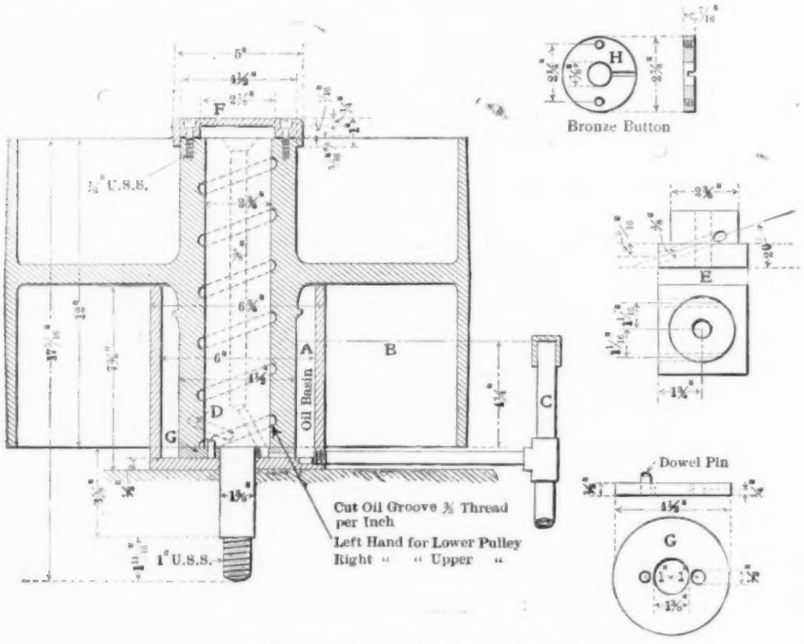
In a certain technical college, when the question, "Why are manholes made elliptical, and not circular?" was put to the class in examination, the majority answered by describing the shape of a man's head or body, or in some other manner going into the details of the human anatomy. The others answered that the reason for making them elliptical is that the covers may be placed on the inside, an operation which would be impossible with a circular manhole.—*Boilermaker.*

CORRESPONDENCE

Discussing Phases of Machine Design and Construction

Some Information about Journal Bearings

The article by James Bell, at page 645, brings to mind a mule pulley I designed for use in the factory here that fulfils the requirements as he states them regarding the oiling arrangements, and has been running satisfactorily three years. This pulley is 18 inches in diameter, running 360 revolutions per minute, carrying a double-thick belt 10 inches wide which transmits power between two shafts at right angles. This general arrangement had been running some years, the pulleys originally being plain cast-iron pulleys, running on tool-steel studs two inches in diameter at the bearing surface and with grease cups at the top for lubrication. The power to be transmitted had been increased until these gave trouble and the pulleys were replaced by others with bronze bushings, loose in the pulleys and on the stud with ¼-inch holes, spaced ¾ inch each way in the bushings to hold and circulate the oil. These answered but a short time and needed constant attention to keep them oiled. Then the arrangement shown in the illustration was made and put in operation.



A MULE PULLEY WITH SPIRAL OIL GROOVE

The principle employed to circulate the oil was new to me, and the article referred to is the first in which I have seen it mentioned.

The pulleys are plain cast iron, no bushing being used, the special feature being the spiral oil groove the full length of the bearing, cut in the right direction to raise the oil from the oil basin up to and out at the top of the pulley. To retain the oil at the top of the pulley the cap *F* was used with packing in the joint and the oil returned through the hole in the center of the stud and hole and groove in the washer *G* at the bottom to the oil basin. This washer *G* was made of tool steel and as the bearing surface seemed ample and it would be completely covered with oil no trouble was anticipated here. We were surprised to have it heat here, even running idle, when testing the circulation of the oil and driving the pulley with a 2-inch belt. Investigation showed that the washer was held in a three-jaw chuck when being faced and sprung from the clamping just enough so the bearing was only at three points. This could have been remedied by grinding the washer to a true surface, but instead the bronze button *H* was made and fastened inside the cap *F* so as to turn with the cap and pulley. It is sufficiently thick to raise the pulley clear of the washer at the bottom and thus bears the full weight of the pulley and carries it on the end of the stud where the diameter is smaller and the friction less.

The hole in the center of this bronze button was made ⅞ inch in diameter because the hole in the stud had already been countersunk to this diameter and so the bearing surface was gone. In making this new throughout, the hole in both stud and button would be made smaller.

The bronze button *H* was fastened in place with the slot down and the outer end of the slot meeting the upper end of the spiral oil groove, so as to allow the oil as raised by the spiral groove to pass through the slot in the button to the hole in the center of the stud. The slot was made deep to carry more oil and also to allow for wear. It was made narrow to save wearing surface, also to retain the oil by capillary attraction when the pulley was at rest so that the oil might be there when the pulley was started.

It will be noted that, when the pulley is running, centrifugal force will tend to send the oil in the groove in the button *H* outward, and the pumping force of the spiral groove must be sufficient to overcome this. The result is that oil in both grooves is constantly under pressure when the pulleys are running, and at each revolution of the pulley every particle of wearing surface is passed over by an oil groove full of oil that is under pressure.

The pulleys were cast from a pattern with a web instead of spokes, and as the oil basin is carried up as near the web as possible there is little chance for dust to get in. The oil basin *A* may be kept filled to the level of the dotted line *B* by the upper pipe *C*, and a faucet attached to the lower extension of this pipe allows the oil to be drawn off whenever the oil may need changing.

To allow the oil to enter the spiral groove at the bottom, a hole was drilled in the hub of the pulley as indicated by the dotted lines at *D*. This does not show clearly the location of this inlet hole, but it extended from the spiral oil groove out through the hub, pointing forward as much as possible to scoop in the oil as the pulley turns and slanting upward to take the oil from above the bottom of the basin and not get settlings, should there be any. For drilling this hole the fixture *E* was made, and used as a jig to locate it. The sketch of this fixture shows more clearly than the pulley drawing the location of the hole it is used to drill.

As is often done for the purpose, a ring was raised on the hub of pulley above the surface of the oil in the basin so that if oil should crawl up on the hub it would fly off and be caught in the basin and not be carried over onto the web of the pulley.

The drawing does not show the supports for the pulley stud as we already had these and the standard patterns for them are too well known to need description here. A. M. GORDON.

Cast-iron Beams—The Neutral Axis and Its Location—A Simple Demonstration—Derivation of a Practicable Formula for Section Modulus

The extraordinary and "mysterious" strength of cast iron against bending, which appears to be contradictory to our accepted theory of strength of material, has been under discussion in this paper for some time.

FIG. 1
W. I. Beam
Uniform Section

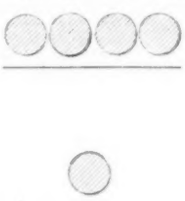


FIG. 2
W. I. Beam
T Section

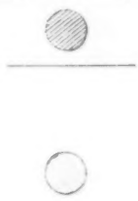


FIG. 3
C. I. Beam
Uniform Section

THE SHIFTING OF THE NEUTRAL AXIS TO BALANCE THE MOMENTS OF THE TENSILE AND COMPRESSIVE STRESSES

It is all the more surprising to see a solution offered passed over quietly and not even Mr. Osborne, the originator of this discussion, mentioning in his last article, page 522, the excellent idea underlying the article written by John Edgar at page 249, who explains that in a material whose tensile strength differs from the compressive strength, the neutral axis adapts itself to the nature of the material and shifts toward the stronger side until the forces are balanced.*

A SIMPLE METHOD OF REASONING THE MATTER OUT

In the following I will show how this problem of cast-iron beams might be attacked and how a result may be reached strictly in accordance with our theory.

Let Fig. 1 represent a beam of uniform section and of a material which has the same strength in tension as in compression, for example wrought iron, and let us for convenience consider the forces and sections concentrated in points A and B. The neutral axis will then be midway between A and B.

Let us now make the side that is subjected to compression four times as strong by adding more material, as shown in Fig. 2; then in accordance with our theory the neutral axis will shift toward the compression side.

A STRONGER MATERIAL AS AN EQUIVALENT OF INCREASED AREA

But instead of increasing the strength of the compression side by adding more material, let us now substitute a section of the same size but made of a material four times as strong, as shown in Fig. 3. Why should there be any difference between these two cases? Is it not natural to suppose that in this case also the neutral axis shifts toward the stronger side?

Reverting to the case of a cast-iron beam it is therefore safe to assume that with increasing load the neutral axis will shift toward the compression side until the outermost fiber on the tension side is stressed to, say, 20,000, and the outermost fiber on the compression side is stressed to, say, 80,000 pounds per square inch.

Assuming a beam of rectangular section 6 inches deep and 2 inches wide, as shown in Fig. 4, if this beam were made of wrought iron the section modulus would be

$$\frac{6^2 \times 2}{6} = 12.$$

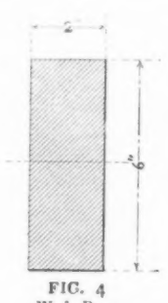


FIG. 4
W. I. Beam

FIG. 5
C. I. Beam

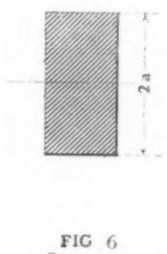


FIG 6
Stress 80,000

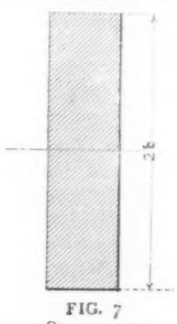


FIG. 7
Stress 20,000

TO FIND POSITION AT THE BREAKING POINT OF NEUTRAL AXIS IN A CAST-IRON BEAM

If, however, this beam be made of cast iron which has a tensile strength of 20,000 pounds and a compression strength of 80,000 pounds, then the neutral axis will shift toward the compression side until the bending moment sustained by the tension side is equal to that sustained by the compression side.

Let a be the distance of the outermost fiber on the compression side, and b that on the tension side, then we may proceed as follows to find the modulus of each part.

Separate the section at the neutral axis, add to each part a section of the same size and strength, but located on the opposite side of the neutral axis, and calculate the modulus of each separately. We will then find,

Fig. 6:

Modulus, $\frac{(2a)^2 \times c}{6}$;

Bending moment, $\frac{(2a)^2 \times c}{6} \times 80{,}000$.

Fig. 7:

Modulus, $\frac{(2b)^2 \times c}{6}$;

Bending moment, $\frac{(2b)^2 \times c}{6} \times 20{,}000$;

and

$$\frac{(2a)^2 \times c}{6} \times 80{,}000 = \frac{(2b)^2 \times c}{6} \times 20{,}000,$$

$$\frac{a^2}{b^2} = \frac{1}{4},$$

$$\frac{a}{b} = \frac{1}{2}.$$

TO FIND THE SECTION MODULUS

In the example we assumed

$$a + b = 6''$$

hence

$$a = 2$$
$$b = 4$$

and

Fig. 6: Modulus, $\frac{(2a)^2 \times c}{6} = 5.33$.

Fig. 7: Modulus, $\frac{(2b)^2 \times c}{6} = 21.33$.

Fig. 6: Bending moment
$= 5.33 \times 80{,}000 = 426{,}000$

Fig. 7: Bending moment
$= 21.33 \times 20{,}000 = 426{,}000$

Total, 852,000

But as we doubled upon the sections, we have to take one-half of this and find as the ultimate bending moment of the original section 426,000 inch pounds.

THE "STRESS IN FLEXURE"

Figuring backward in the customary manner we would find the following:

Modulus of section, 12.

Ultimate bending moment, 426,000 inch pounds.

Stress, $\frac{426{,}000}{12} = 35{,}500$ pounds per square inch, which figure agrees well with those given in text-books, and also corresponds closely to figures obtained by actual tests.

*The shifting of the neutral axis as fracture is approached has been elsewhere referred to in our columns, we presume since the above was written.—Ed.

A FORMULA FOR SECTION MODULUS OF A CAST-IRON BEAM WHICH TAKES ACCOUNT OF THE DIFFERENCE IN ULTIMATE TENSILE AND COMPRESSIVE STRESSES

Considering the above to be correct and in accordance with actual tests, a new formula can be calculated for the modulus of section of a cast-iron rectangular beam.

We have seen that

$$\frac{a}{b} = \frac{1}{2},$$

and $$a + b = d,$$

from which we find

$$b = \frac{2d}{3}.$$

We have also seen that the section modulus for a stress of 20,000 pounds was

$$\frac{(2b)^2 \times c}{6}.$$

Substituting in this expression the value of b just found, we have

$$\frac{d^2 \times c}{3.375}, \text{ or } 0.3d^2 \times c, \text{ nearly.}$$

APPLICATION OF THE FORMULA

I have before me specifications for some machinery to be furnished to the Government, wherein a test bar is specified 2 inches wide, 1 inch deep, to stand a central load of 2000 pounds, resting on supports 24 inches apart.

The bending moment in this case is

$$\frac{2000 \times 24}{4} = 12{,}000 \text{ inch pounds.}$$

The section modulus would be

$$0.3 \times 1^2 \times 2 = 0.6,$$

and the tensile strength of the cast iron will be

$$\frac{12{,}000}{0.6} = 20{,}000 \text{ pounds per square inch.}$$

F. F. NICKEL.

Keeping Track of Drawings in the Machine Shop

When, as is often the case, a great number of drawings are used in a machine shop, and these drawings are being constantly changed, some method of instantly locating every print is necessary.

In the shops the writer has in mind, there are in more or less constant use several hundreds of drawings. Improvements are being constantly made to the manufactured product, and naturally this calls for frequent changes in the drawings. In order that, whenever a change in a drawing was made and new prints issued, the old ones might be located and returned to the drafting room without loss of time, the following simple but effective system was devised:

When received in the shop, all prints are filed in numerical order in a filing cabinet similar to that shown at page 829, Vol. 29, Part 1. When issued from the drafting room, they are accompanied by the card shown herewith. Upon receipt, these latter are placed in an index file and when the foreman desires a man to use a print, it is given to the latter and his number and name with the date are placed on the card. When the workman returns the print, the date of return is placed in its proper place on the card. As will be seen, several spaces are provided on the card, in which to place the number of prints issued to the shop.

This card therefore serves as a complete, detailed record of every print charged against the shop. For example, the card shown herewith indicates that four prints were received and that later one was returned to the drafting room, leaving three still in the shop. The card also shows that two prints were issued to the workmen, that one print is in actual use in the shop, and that two others are in the cabinet.

This system of keeping track of the shop drawings has been the means of saving a great deal of time in locating obsolete prints and has also served to prevent these superseded drawings from being mislaid and then being picked up and put into service again. When this system was installed, prints were disappearing no one knew where and the cost of replacing them was considerable. Every effort was made to overcome this, but it finally became necessary to fine each workman losing a print. No matter how torn or oily a print might be, he received credit for it, but if he failed to produce it in some form a small fine was deducted from his pay at the end of the week. This soon put an end to the disappearance of the prints, and no further trouble has been encountered

A complete list of all drawings is kept in a loose-leaf folio. This is arranged alphabetically and serves to give the drawing number when a print is required.

A. J. W.

SHOP DRAWING RECORD DR. NO. 913-5

NO. PRINTS AT HAND 4 3

NO.	ISSUED	WORKMAN	RETURNED
1	June 16, '06	S. Hill, 312	June 17, '06
1	June 18, '06	R. Wills, 716	

SHOP DRAWING RECORD

Hardening Scriber and Compass Points

An excellent way of hardening scriber or compass points is to heat them to a cherry-red, then force the points immediately for a few seconds into a piece of soft wood and instantly after that plunge them into cold water. No tempering is necessary as it will be found that they are hard enough to scratch glass without being too brittle. KURT STOYE.

"Tempering Novo Steel with Cyanide" — Determining the Action of Cyanide on Tool Steel—Distortion of Carbon Steel hardened in Water and in Oil—Identifying Tool Steel

I was interested and somewhat puzzled by Mr. Ashley's letter at page 639. It is not clear to me just what he wishes to prove, and his experiment, as described, does not appear to be very conclusive. If he wished to prove that tool steel treated with cyanide could or could not be annealed, it seems to me he should have treated the No. 1 bushing with cyanide and hardened it, then reheated it and allowed it to cool slowly. The result would have been the same, of course, for as I understand the matter; cyanide introduces carbon into the immediate surface of a piece of iron or steel to which it has been applied, and all the directions for its use that I have ever read state that the article is to be quenched while at a red heat in order to harden the surface so treated; the plain inference being that a piece treated with cyanide will anneal just the same as any carbon steel, if treated in the same manner.

Further on Mr. Ashley says, "No. 3 [bushing] was just as it was before it went into the fire." This would be equivalent to stating that it also remained soft, which would not say much in favor of the use of cyanide as a hardening medium, but from the context and my knowledge of the action of fire and oil on steel, I infer that he intended to say that the No. 3 bushing had not changed as to size or shape in hardening. Assuming that my previous assumptions are correct, Mr. Ashley has still not shown anything very definite in favor of the use of cyanide on tool steel, for when hardened in oil without any treatment at all, it will usually show less shrinkage and distortion than when hardened in water, for the simple reason that it hardens more slowly and less hard.

A SUGGESTED EXPERIMENT

If Mr. Ashley will make say four such bushings as he describes, all from the same bar of steel, and all exactly alike as to

size and shape, heat them all alike, treat two of them with cyanide, harden one of these in water and one in oil, then harden one of the remaining two in water and one in oil without cyanide, force these bushings into holes exactly the same size in pieces exactly alike and note results as to size of hole, etc., he will have obtained much more definite information as to the relative value of cyanide, oil and water as relating to distortion and shrinkage than he could possibly obtain from the experiment he describes, but he will still have to take into account possible variations in the steel due to the treatment that it received before it reached his hands.

HIGH-CARBON STEEL HARDENED IN WATER

It is a mistake to assume that all high-carbon steel will shrink when hardened in water, as this is not a fact, as I have learned, to my sorrow. Some steels, particularly if thoroughly annealed, will swell in hardening, and it is not even safe to assume that all parts of the same bar will act alike in this respect. I have had a small piece 3/8 inch thick swell 0.002 inch, and only recently a punch hardened in water swelled 0.01 inch in a length of about three inches; I have also hardened small pieces in water which retained both size and shape, and of course have had them shrink, and I have never yet been able to form any definite estimate as to how a piece would act until I hardened it. If Mr. Ashley or anyone else has any scheme or treatment that will insure that any given piece of high-carbon steel will harden uniformly hard, and still retain both size and shape, I would like to know about it. I am not writing this merely to criticize, but to obtain information. I must say, however, that I doubt the value of cyanide as a means of preventing shrinkage or deformation, as its action is confined to a very thin skin on the surface of the steel. I use it occasionally on a piece that is the full size of an annealed bar in order to restore the carbon to the partially decarbonized surface, and insure against soft spots, but I consider its use on all high-carbon steel as superfluous at least, as I have never had any difficulty in getting all the hardness I want if I use the proper grade of steel.

CYANIDE ON NOVO STEEL

Novo steel I understand to be what is known as a tungsten steel among steel makers, and it is worked at a heat that tends to burn out any uncombined carbon. If this is the case, then it would seem that the introduction of carbon by means of cyanide, and then burning it out again in the final heating would tend to leave the surface affected by the cyanide in the condition of overheated carbon steel.

While I am not inclined to favor the indiscriminate use of cyanide, yet at the same time I do not feel disposed to criticize anyone who does use it, for if by so doing he gets results satisfactory to him and his employer that alone should justify him in continuing its use; the only question I would raise, is whether or not it be possible to secure equally good results without it.

DISTORTION OF CARBON STEEL

The difference in the amount of distortion in a piece of carbon steel hardened in water and in a similar piece hardened in oil becomes very marked when the pieces are very thin. A disk say 2 inches in diameter and 1/32 inch thick will almost invariably warp all out of shape when hardened in water, and if quenched in oil and allowed to fall through the oil into water below, will still warp or dish, although not to so great an extent as in water alone; and I was very much astonished to find at one time that a very little water, just about enough to wet the sludge in the bottom of the tank, had spoiled a lot of such pieces. I found this water by the freezing process. From 75 to 80 per cent. of these pieces hardened in oil will come out the same shape as before they went into the fire, and most of the balance are only slightly dished, and hardly one in a thousand will crack. I find that the speed of the preliminary heating of these pieces, that is, from cold until they begin to show red, has a decided effect on the amount of distortion. If a cold piece is put directly into the full heat of the fire, it is much more apt to warp than if heated up slowly.

TAKING CARE OF THE TOOL-STEEL STOCK

One important detail that has a bearing on this subject that does not receive sufficient attention in many shops, and is overlooked entirely in some, is the care of the stock of tool steel. This will usually be found in the smith shop mixed up indiscriminately with all kinds of scrap, and about the only information to be had about it is that some is annealed and some is not; worse than this, perhaps, is the fact that in many cases all steel looks alike to the purchasing agent, and if he buys "Gingerson's" or "Black Jack" brand it must necessarily be good enough for anything. The consequence is that tools are made from steel not suited to the work and the hardener who may have only a common open forge for heating his work, so placed perhaps that sunlight may fall upon the fire some part of the day, will get the blame for the failure of the tool. I think that all tool stock should be kept in such shape that the grade, temper, etc., and any special characteristic of each bar may be readily known. As paper labels are soon torn off the bars, and it is hardly practicable to stamp all information on the bar itself, probably as good a plan as any is to mark the bar with a number or character every few inches, so that as long as any of the bar remains its mark can be found, and keep a record of it in the tool room, so that a toolmaker may know as accurately as possible just what to expect from any given piece.

W. L. HARDY.

Boring Bar and Cutters

Figs. 1 and 2 show one of a set of boring bars and cutters for general shop use. Fig. 1 shows how the bar and cutters are used for duplicate and the more accurate kinds of work, and Fig. 2 shows how the bar and cutters are used for ordinary or jobbing work. In Fig. 1 a floating clamping device is used for holding the cutters, while in Fig. 2 the ordinary taper wedge is used, the bar and cutters being suitable to use both ways. With the floating clamping device, consisting of a screw and two wedges of thirty degrees' angle, it is impossible to spring the bar and get different dimensions in each hole bored with the same cutter, because the clamping strain is equalized on each side of the bar. When using the wedge, which has its

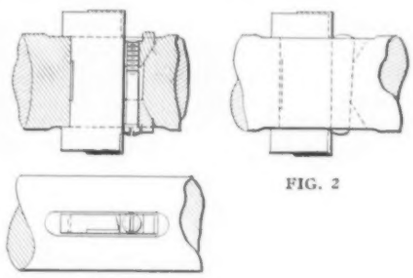


FIG. 2

FIG. 1

BORING BAR AND CUTTER FOR GENERAL SHOP USE

bearing near the center of the bar, there is little chance of springing the latter when used for ordinary work. As shown in the sketches the thickness of the cutter is equal to one and one-half times one-eighth the diameter of the bar, and its width inside the centering projection is equal to four and a half times one-eighth the diameter of the bar. The taper of the wedge is half inch per foot, and its width is equal to its thickness at its small end.

H. E. R. MANBRAND.

Manufacturing Code Words

It is often desirable to have private code words for machines or parts of machines. The selection of suitable words was a perplexity to me until about one year ago, when I devised a scheme for originating such words. With the idea that someone else may possibly be helped over the same path I submit the following formula: Let each of the ten digits be represented by a consonant and a vowel, of which 1 might be represented by bo; 2 by cu; 3 by di; 4 by fa; 5 by ge; 6 by ha, 7 by ko, 8 by lu, 9 by pe, and 0 by ra.

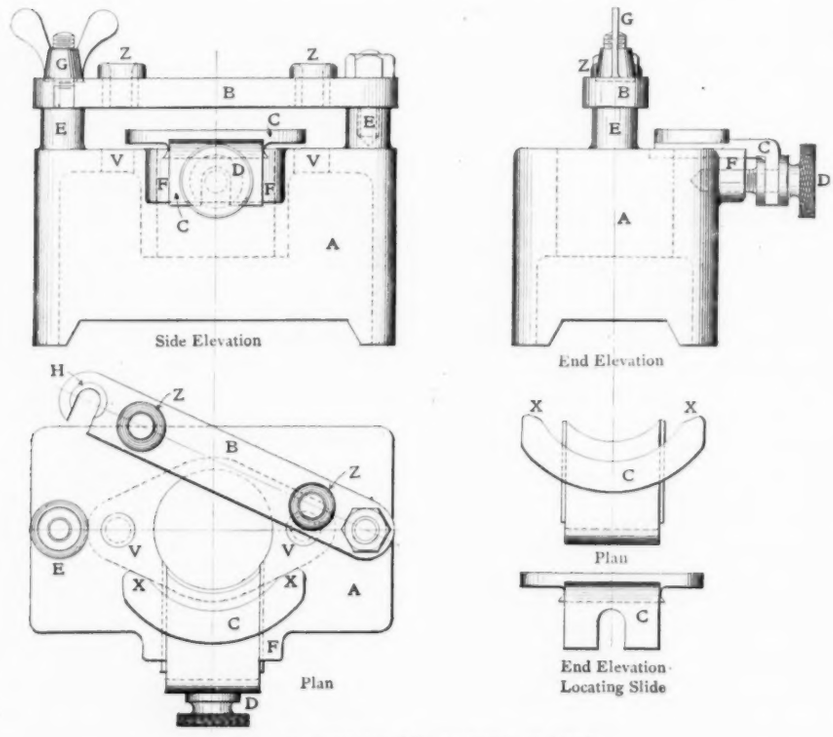
To derive a code word one has only to give the machine or its parts a number; this number might be actually the number of the machine or one given to it for the purpose of deriving the code word.

Suppose we have a line of six lathes to which we wish to give code words; we first give them numbers, 132, 175, 450, 672,

1050, 2447, and the code words would then be respectively bodicu, bokoge, fagera, lakocu, boragera, cufafako. Of course, a sentence or phrase can also be numbered and code words given to it. It must be evident that no number below 100 can be used, and no number should have the same digit occurring more than twice; that is such numbers as 4555, 222, should be avoided. C. R. HARRIS.

Jig for Drilling Steam-Pump Glands

Having large quantities of stuffing-box glands to drill for steam pumps we designed the jig here shown, which gives entire satisfaction, and insures them being absolutely interchangeable, a very important feature when assembling in quantities. *A* is a gray-iron box casting, bored to receive the gland—which should be a nice fit without any shake, and is shown dotted in position in the plan. *B* is a swinging crossbar carrying the two drill bushings, as shown marked *Z*. *E E* are two supports for carrying the studs for pivoting and locking *B*, the latter having a recess 1/16 inch deep shown at *H* in the plan. This insures it being exactly central before the wing nut *G* can lock it in position for drilling.



JIG FOR DRILLING STEAM-PUMP GLANDS

C is a locating slide for setting the glands exactly central and locking them at the two points *X X*, while being operated on. *F* is a lug cast on *A* to give additional bearing surface to *C*, which works in a dovetail slide as shown, and is operated by the nurled screw *D*, in the manner shown in the end elevation. The front portion of the slide *C* is lower than the back part, and does not stand above the top of the casting *A* when in position, so that it does not interfere with the flange of the gland before the points marked *X* come into operation. The two holes marked *V V* are directly beneath the holes to be drilled in the gland, and are ¼ inch larger in diameter than the latter, which allows all the chips to drop through.

To put a gland in the jig *D* and *G* are slackened and *B* swung back. *D* is then tightened up which both locates and grips the work, *B* is then brought into position and locked by *G*, which fits into the recess *H*, and the work is then ready for drilling.

England. "STEAM PUMP."

"Specialist versus the All-around Man"

The full-blown concern manufacturing a regular line of machines and having repetition methods as near perfection as possible, is apt to look down on its poor relation, the jobbing shop. But if it correctly gaged the situation it would rather express its gratitude to the latter for relieving it of much that is bewildering and brain-racking in the mechanical craft. For their very existence as repetition shops is possible only by virtue of the coexistence of shops that will undertake the odds and ends, the repairs and "while-you-waits" that must be done by someone.

THE JOBBING MECHANIC

A long experience of job-shop practice and a fair idea of the ways of its more aristocratic brethren, convince me that the former calls for as much if not more of the real mechanical instinct than the latter. Take a gas engine: Put a fitter from the engine-building shop—the shop with the inspectors, speed men and refinements galore—against a repair job and he will flounder hopelessly. The reverse is not the case. I am prepared to admit that the jobbing mechanic is not the type of man he was twenty-five years ago; that he lacks the old-time initiative and confidence in himself; that he blunders more frequently and altogether takes more supervising. That this is due to the influence of the repetition shop is also certain.

ALL-AROUND MEN BECOMING SCARCE

But after all the job shop is the real crucible in which the native resource of a man is gotten out and I have often wondered where the supplies of the future will be drawn from. Repairs to manufacturing plants must be done. Lifts will continue to stick on occasions. Shaft bearings will seize, gas engines refuse to fire, valves will leak. As machinery multiplies, repairs will also, but mechanics of the necessary sort are not being manufactured *pro rata*. The big shops don't turn them out, and our apprentice system doesn't help, and, as a consequence, the supply is never equal to the demand. What is known as the all-round man is to my thinking rapidly becoming extinct. This, according to the writer of the article at page 515, is a blessing, but if it is true who is to do repair work?

THE SPECIALIST IN THE REPAIR SHOP

I disagree entirely with your correspondent when he says that a specialist "can do any work he is likely to be given in a small repair shop." My experience teaches me to shun the specialist who by virtue of the narrow field in which he works is unfitted to cope with the widely divergent requirements of job-shop practice. Ninety-five per cent. of the specialists we have tried are not worth shop room to us, and they are the ones who go away and say the job shop is a scrap heap—no brains, no system, no anything but makeshifts. This seems to be the idea fixed in your correspondent's head.

AN UP-TO-DATE JOB SHOP

Now we reckon to do well-nigh anything from sinking a well to mending a sewing machine. We are not by any means a model concern, but we do manage to preserve a certain amount of routine. We have a proper system for incoming and outgoing material, a workable cost department (which I have described in these columns) a fairly accurate idea of the amount and distribution of establishment charge; we use the card index freely, all shop orders are issued on proper forms, each job bearing a number which follows it from the order book to the led-

ger; tools and materials are only issued against the foreman's written order.

Our tools are kept in good condition, and while there are some back numbers among them there is a fair sprinkling of the other sort. These latter include a Whitcomb planer, a Lodge & Shipley lathe, Cincinnati miller, wet tool grinder, Cincinnati universal grinder and several Barnes drills; not a disreputable company even for a specialist.

REPETITION METHODS AND JOBBING REQUIREMENTS

The fact of the whole matter is the specialist and his repetition methods are no good to us. We don't want to know how to make a gross of keyways in the time we now take to make a dozen, for the simple reason that we never get a gross of a sort to make, and the cost of tackle to effect the economy would throttle the job. The man who can machine bearings in record time and turn them out like shelling peas, is not so good a man for us as the one who can make the same bearing run cool by the shortest cut. While the specialist was working it out in algebra and fumbling for what he affectionately calls his "mike," the job-shop man would be through. I don't blame the specialist, because it is a case of a square peg in a round hole.

He can do the job, of course—if you give him time; but that is usually just what we can't give him. Keeping cool and keeping his eyes open don't count if there is missing that unorthodox and audacious lack of system that is characteristic of the job-shop man.

A——, England. JUNIOR BOSS.

The Manufacturer, the Dealer and the Customer

An incident which happened so long ago that none of your readers can connect it with any existing firm, brought out a question of ethics which undoubtedly has its parallel repeatedly and a discussion of which may help to solve the perpetual riddle of the relations of dealer, manufacturer and customer. The matter, to strip it of all warm and personal letters which passed, was like this: A manufacturer of metal work, a sort of rolling mill concern, A, wished to install some new trucks of a special nature. B, a dealer in supplies, took the matter up with C, a blacksmith, submitting A's blue-prints and receiving a bid from C for the work. No specifications were made on either side as to workmanship or material, beyond specifying "steel" or "wrought iron." B placed an order for the goods over his own name with no mention of A other than that the goods were to be shipped to him when completed.

A week or two after the forgings were shipped, C wrote to B saying that A claimed the forgings to be worthless, and saying among other tactful things that while he did not know anything about the forgings from observation, he had known A so long that he had no doubt that he was right. As C was otherwise engaged he got me to go and see A to find out what the real trouble was. I went and found, after sifting out the chaff from the wheat, that there remained two complaints, one that the forgings were not smoothed up nicely, the other that certain pieces were not nicely welded. The first was

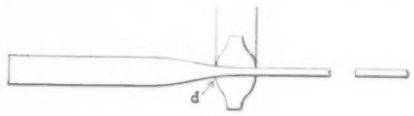


FIG. 1

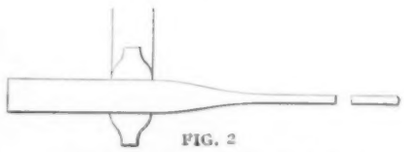


FIG. 2

METHODS OF BREAKING THE DIES

undeniable; the forgings were rough, just about what I had been in the habit of seeing in structural work, so I thought that they ought to answer. The man who seemed to be responsible for the matter showed me two or three of the forgings which had broken in testing. At first I was stuck; they were broken clearly enough, and he said he did it with one hand. When I looked closely it seemed to me as if at least three-fourths of each break was through clear metal and about one-fourth in the weld.

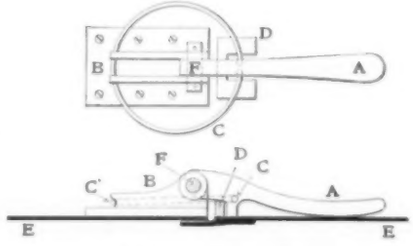
When I called his attention to it he offered to break one and let me see. Fig. 1 will illustrate what he did. The pieces in question had been made by drawing down a piece of ¾x2½-inch soft steel to ½x1¼ inch at *d* and welding on another bar of the latter size some six or eight feet long. Gripping the piece in the vise as shown with the weld just at one side of the vise, he grabbed the short large end and with about the third bend broke it off short at the vise. This break was better than any of the others, only a spot about 3/16 inch square peeling in the weld. In spite of this he still stuck to it that the weld was bad. I took one in the vise gripping it back on the large part, Fig. 2, and let him bend the small part back and forth till he was tired without breaking it. Then I told him that I had just time to catch a certain train home and that unless there was something more to be said I would take it. Then he spit fire. He wanted to know what I was going to do about the forgings. I told him that I had no right to have any dealings with him in the matter, that I was working for C and that C was entitled to, and would get, my advice which would be to collect his bill from B.

Eliminating, as I said above, the warmth of the conversation the upshot of it was that B disclaimed any responsibility in the matter, said that the forgings must suit A before they were paid for. After a time the matter was finally settled by C's taking the rough forgings home, heating them up and running a flatter over the flat parts and then oiling them and burning off the oil. This treatment so smoothed over the welds that they passed muster and A's superintendent thought they had been re-welded.

The question, beyond the evident unfairness of a test like that shown in which the way the piece was held in the vise concentrated the stresses in a small spot, seems to be whether a dealer who appears to act for himself can ethically be called upon to stand on his own bottom. If he was acting for the manufacturer and selling on commission so that the real trade was between manufacturer and customer, then I could see it, but where a man represents that he is buying to sell again at his own price I fail to see why the manufacturer should have to go beyond him in his dealings. ENTROPY.

A Simple Spring Tension for a Handle

Some time ago I had shipped to me an electric controller which had a unique fastening for the sheet-iron cover, the novelty consisting in the method of holding the latch in place after it had been closed. The particular feature of the device was a heavy wire ring of spring steel about No. 8 Brown & Sharpe gage. This wire ring is snapped into the closing handle, and is looped over a projection. As the handle is closed it is stretched into an ellipse. The main points of excellence seemed to be its cheapness and the fact



A SIMPLE SPRING TENSION

that by using a vise or a sledge to bend the ring more or less the degree of tension could be varied.

It seemed to me that this could be used in many places where a fastening that would stay fastened was needed.

In the illustration *A* is the pivoted latch which hooks down over the projecting piece *D*, thus holding the edges of the plates *E* together. The steel ring *C*, which hooks over the projections on the pivot piece *B* is so arranged that when the latch is closed the ring is stretched apart, the tension acting below the pivot point *F* tending to keep the latch closed.

MICHAEL MAC MICHAEL.

Cast-Iron Beams—Assembly Drawings for Pattern-makers, etc

A splendid opportunity to digest the matter in the AMERICAN MACHINIST came to me the other evening. I wanted to come out to my cottage—the one I wrote you about building, at page 93. A derailed car cost me my ride up so I walked. It snowed when I started so I pulled down my cap over my ears. Then there was no excuse for my doing anything but think (that is besides walking), for I couldn't hear anything.

THE CAST-IRON BEAM SUBJECT

What more natural than that I should begin to think about cast-iron beams and Mr. Osborne's contribution to knowledge by starting the subject going. I don't think that the question itself is really worth discussion as things stand now, but the cast-iron business is likely any time to be lifted out of the dark ages into the light of civilization.

INFLUENCE OF THE AUTOMOBILE BUSINESS

The automobile business is having its effect. There is nothing like an expensive, profitable toy to stir things up. The automobile makers seem to be a little particular about their castings so they use air furnaces; just so they can control their mixtures and heat and keep out some contamination of fuel, etc. If they should ever get where a customer can rely on what he will get when his bill calls for "gray-iron castings," then all this discussion will be of great use, and it looks to me now as if there was a fighting chance.

TEXT BOOKS

Mr. Osborne and Trautwine have had their shot at the books and so have I, but it is like the minister that lectured the part of his congregation that came to church on a stormy night because the rest stayed away. The folks that write books do not read the AMERICAN MACHINIST. They read *Punch* and the other English great guns. The only way to get a text book to suit Mr. Osborne or myself is for us to write one. I can imagine some gray-haired old professor pushing his spectacles on the end of his nose and writing a review of the book warranted to scorch a hole through the printed page before the article got to the reader.

THE NEUTRAL AXIS

After all, all that is necessary in this cast-iron beam business seems to be to catch the neutral axis. You find that and get it right and you have the whole thing where you can use it. After that you have got to find out why the neutral axis is there, but that will do for the professor, we can get along with the other thing for a while.

CHECKING DRAWINGS

While considering these things I had been walking along and as I struck an open bit of road and the snow flakes began to come with needles in them my line of thought was broken off and when I struck into the woods again and began to be comfortable I happened to think of W. Alton's plea at page 641 for some way of getting a draftsman to check his work more carefully. My experience has been almost entirely with cast-iron work. What little steel we use is almost entirely in shafts. We have almost no forgings. My way has been to make assembly drawings with dimension figures on for all finished surfaces and send them out for the pattern-maker to use. My experience has been that working in this way very few errors get past the patternmaker.

CO-OPERATION OF DRAWING ROOM AND PATTERN SHOP

To make this work well you have to be certain that no jealousy exists between your drafting room and pattern shop. You cannot in fairness make the pattern-maker responsible for a draftsman's blunder, but if both are really working for your interests and if they are perfectly free to consult with each other and with the machine-shop foreman then you can get along with a minimum of friction. This reminds me that one of the most difficult things to do is to preserve authority without anyone under you feeling as if he was under your restraint.

AN IDEAL EMPLOYER

Not long ago I was talking with the head draftsman of a large firm near here, and I asked him how he liked Mr. Blank to work for, Mr. Blank being the member of the corporation who had directly to do with his work. "Well," he said, "he is the finest man to deal with I ever worked for. Why, instead of sending a boy out here to call me into the office to talk with him, he sort of happens around and says: 'Say, Bill, when you are up my way drop in, and we'll see what we can do about that planer feed,' and after I have been up there and talked it over and come away I know perfectly well that he has given me an order to do certain things, but I'll be blest if I know just when he gave the order."

A MASSACHUSETTS GUIDE-BOARD

Up here at a corner of a road is a sign-board that reads: "— miles to Boston," just how many does not matter, but the point is that some boy has printed after Boston the word "Tech." It was too dark to see it the night of my walk, but I know it is there. It reminded me of the report at page 628 of Mr. Taylor's address at the University of Pennsylvania. It is very seldom that it is possible to get a fair expression like this from an employer as to the value to his business of technical graduates. I realize this from the fact that I have attended a technical school, have taught in one, and have employed some of their graduates.

A PLAY SPELL FOR TECHNICAL GRADUATES

I realize, too, without reading this report that Mr. Taylor is the personification of the strenuous life. Two years to get into harness seems to him a waste of time. That is what my father thought at that period of my life. I never had that play spell. I miss it now. I believe that any young man is entitled to have just that relaxation that he gets now. To say to a technical student that he is having the snap of his life seems to him ridiculous. He will point out to you that his schedule calls for an average of nine hours a day recitation, study, shop and laboratory practice, and drawing, for six days in the week, and he will tell you that it takes more time than that to do the work. Then you watch him work.

HOW SOME BOYS STUDY

One night recently I was calling at a house where three of these students room. I outstayed good manners as long as I dared to see if they ever would settle down to study. At half-past 10 they were still talking. Each one in his room "studying" with the door open and shouting to the others. The people who own the house told me that they seldom put out their lights till after midnight, but that they often wondered when they did their studying.

THE YOUTHFUL MIND

I do not believe that these boys are in a psychological state to concentrate their minds enough to study as they ought. I don't believe that working in a shop alongside wage-earners would have the slightest influence on them. In fact, of these three boys two have worked and earned a good part of their way through school. They have not the slightest distaste for work. If they should feel the gnawing of hunger, know that wife and babies at home were suffering for the pittance that they could bring them, then they would realize the stern lesson that the world has for every man sooner or later.

THE PERIOD OF UNREST

But is it best for them to be brought to face such things at this stage of life? I think not. The maturity of mind which can use a technical education does not come till 25, on the average. Before that there is an unrest, not due to training, but to the growth of body and mind, that is as natural as it is for the snowflakes to tumble and toss about ultimately to find their resting places, and form a unit of a great and harmonious whole.

ENTROPY.

Apprenticeship and Apprentices

The report of the apprenticeship committee of the National Machine Tool Builders Association at page 668 is interesting reading for those who have to

contend with securing machine-shop help at the present time. There are many data arranged in percentage form which are doubtless useful, and we find fourteen counts summarized in one paragraph which states that inasmuch as there is an insufficient number of skilled workmen we can only increase this supply by teaching the machinist's trade to an increased number of boys—and that, finding difficulty in producing a sufficient number of boys for this purpose, we must offer inducements which will attract them to the trade.

"Producing" is a good word, in view of the recent agitation relative to race suicide, and it might be well to begin at the bottom of this question and produce more boys. There are not enough boys of all kinds to give us the required percentage of good ones.

All of us who have handled boys in a practical way must agree that at the present time inducements must be offered to attract them and to determine these inducements is what bothers. The committee might have gone a little farther and helped us out on this point. I have tried inducements such as good wages and gifts of tools and have agreed to give the boys instruction in drawing, etc., at night but could never get a "quorum." The boys are suspicious and think we are teaching them solely for our own benefit. The committee speaks of an apprenticeship agreement which is binding and I should like very much to see a uniform apprenticeship contract or any other kind of an apprenticeship contract which is binding, especially on the apprentice.

FIXED WAGE RATES WRONG

I agree with the committee in that the rate of wages should be optional with the employer, yet I believe that this whole system of a fixed rate for the various periods of the term of apprenticeship is wrong. The rate should be left blank and be filled in by the foreman to suit individual cases. I believe the apprentice boy should be paid in accordance with his ability to learn and his productive power. We all know what a difference there is regarding the quality of our journeymen and there is an even greater difference among the boys. The premium system is an incentive to the boy to increase his usefulness to himself as well as to the employer, but it is not practicable to use this system until a plant is placed upon a thorough manufacturing basis.

Some boys are capable of mastering a fairly good trade in three years while others may work at it for four or more and not become proficient.

FAULTS OF THE UNIFORM AGREEMENT

A uniform agreement (with a fixed rate of wages throughout the term) keeps down the bright, ambitious boy and bolsters up the "no account." As soon as a boy signs an agreement for a period of, say, four years at fixed rates of wages throughout that period, right then he signs away his ambition for that period unless made of unusually good stuff. For the above reasons I would prefer to have the right to advance the boy's wages as often as he can demonstrate his increasing usefulness.

I have hired boys as apprentices under the National Metal Trades agreement which allows the boy 8 cents per hour for the first period of 1350 hours, 9 cents for the second period of 1350 hours, etc., until the last period of 1350 hours for which he receives 15 cents per hour and I have found that in most cases the boys who are anxious to sign this agreement are not so desirable as those who do not sign. It is also a fact that about 10 per cent. of the boys who signed the agreement finished their term. Most of 90 per cent. "blew the job," as they termed it, and the balance were so utterly hopeless that it became necessary to discharge them.

CITY AND COUNTRY BOYS

A uniform agreement would be ideal if we had uniform boys. Those of us who have the city boys to deal with have a decidedly different proposition on our hands from our brothers located in the small cities and villages. The city boys usually work because they have to; the country boys or boys from the villages because there is nothing else to do. When they reach that age where it seems to them unmanly to attend school any longer, they have to go to work or be lonesome and so choose the former. I believe that the inducements are sufficient for the city boy, but the city boy is not sufficient for the inducements. In most cases the boy not raised in a large city is superior mentally and physicallly to the city boy and it is my experience that he makes the best mechanic.

There are thousands of boys located in villages near large cities who are either doing work which is not congenial or are loafing at the country store waiting for something to turn up. It might be well to offer inducements to this class of boys. They cannot pay board at a wage rate of 8 cents per hour and have anything left for clothes, tools or spending money.

FURNISHING BOARD AT COST

Why not establish an apprentices' boarding house and, while they are serving their time, board them at cost? A sort of a night boarding school could be arranged with classes in drawing and mathematics so that those who were willing could avail themselves of such an opportunity. This would attract a class of boys from the country who could learn their trade and at the same time pay their way. If we board the boy at cost he is not an object of charity and would not feel so. He pays for what he gets without the added profit.

NO TOOLS AS PRESENTS

The boys should buy their own tools rather than have them given them. The tools would then represent a value and right here is something which I have always noticed, namely: The boy who is anxious and willing to learn, no matter how poor, always manages in some way to get tools, while, on the other hand, the indifferent apprentice is continually borrowing. ART ISAN.

Scheme for Lifting the Planer Tool on the Return Stroke

One of the men on the planers had a little scheme in operation the other day; I thought it about the best thing yet, and something new as far as I know.

He had to plane a number of creases in a lapping block and getting tired of lifting the tool up at every return stroke made the little thing, shown at *A* in the illustration, to hold the tool out of the creases so as to feed for the next cut while

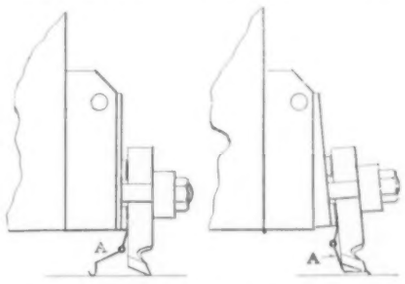


FIG. 1. Cutting FIG. 2. Returning

LIFTING THE TOOL ON THE RETURN STROKE

the tool was returning. The device was made of thin sheet copper, one end put under the tool and clamped by it and the other end curled up to form a hinge. To this piece was added another piece with a hinge on one end, the other bent to carry the tool. A wire was slipped through the hinge and it was done.

It was also used for other purposes in work where the return dulls the tool, such as replaning old surfaces, etc., and it proved itself a good thing. ARTEBE.

[We have shown various devices for this same purpose but do not recall one with the end bent to reach under the tool and thus prevent the point striking the rear end of the work when falling to cutting position. A thin flat spring, say a piece of old clock spring, a piece of sole leather or a common strap hinge will lift the tool on the return stroke. Any one of these is very handy when planing T slots, where omitting to lift the tool is likely to cause things to happen.—EDITOR.]

The Cincinnati Milling Machine Company, of Cincinnati, Ohio, issues a pamphlet entitled "Examples of Rapid Milling," which, although they state it is used as a supplement to their complete milling-machine catalog, is yet not in reality a catalog, but is simply a small book illustrating and describing certain typical jobs of fast milling, which are regularly done upon their machine, and which very well show the capacity of the modern miller.

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Mr. Carnegie on Wealth

Millionaires and multi-millionaires discussed at the meeting of the Civic Federation in New York, the question of what should be done with themselves; evidently perceiving clearly enough that something is likely to be done.

Andrew Carnegie, who when he talks usually says things worth hearing, and whose words are especially likely to be weighed by engineers everywhere, expressed the belief that the community had more to do with the building up of large fortunes than individuals had, gave examples of the creation of such wealth by the natural growth of the community that would have delighted the heart of Henry George, but deprecated any attempt to interfere with the bee while it is busy gathering honey. He favors, however, an inheritance tax and believes the community may properly come into most of its own by taking from a departed millionaire's estate a large share. What is left Mr. Carnegie thinks is all that will be good for the orphans, many of whom are ruined by having too much wealth thrust upon them, and being thereby relieved of the necessity of working.

It seems likely, however, that people will interfere more or less with certain kinds of bees. No bee has ever been known to do aught else than simply gather honey, leaving to all the other bees an equal opportunity to do the same thing. If honey-bearing flowers are scarce they are scarce for all bees alike, no one bee or group of bees attempts to set up a monopoly of them and prevent other bees from working. And when the winter is long and hard all fare alike in the results of their common industry. Just here is an important difference between human bees and the other kind, and we believe that Mr. Carnegie, upon looking into the matter a little further, may see reasons why some human bees may properly be interfered with during the honey-gathering process; not, of course, to prevent their gathering honey, but to prevent their interference with others who want to gather their share of it.

We do not need to curb industry and enterprise, nor do we need to break up or interfere with hives that have grown larger than others, or by greater industry have accumulated more honey, but it is becoming more and more clear that something must be and will be done to secure for each hive and for each bee equal opportunities and a "square deal."

Those other millionaires, Perry Belmont and M. E. Ingalls, both well known, not only as successful men of affairs, but also as men who are in the habit of giving some thought to public affairs and to civic duties, differed from Mr. Carnegie somewhat as to what is the matter, and what should be done to cure it, but agreed that something is the matter, and that remedies ought to be found and applied.

When those who suffer by present maladjustment are joined to this extent by those who seem not to suffer by them, at least pecuniarily, the outlook is certainly most encouraging, and he must be a confirmed pessimist indeed who can believe that a proper and just remedy will not be found and applied.

The Art of Cutting Metals

As discussion of Mr. Taylor's presidential address before the A. S. M. E. goes on, it is becoming more and more clear that it is really a monumental piece of work—undoubtedly one of the most notable papers ever presented before any professional or technical society. Its importance is the more clearly apparent, of course, because the work it describes has gone on for 26 years without being revealed to any except participants in it, so that it comes upon us all at once instead of having its force weakened by gradual or piece-meal publication.

"What speed and feed shall I use?" is a question that has presented itself to every machinist, thousands of times, and has as many times been answered not vocally but by the flipping of a belt and the changing of a gear. In every one of these thousands of answers there has been a large element of guesswork; tempered, of course, by experience or educated judgment, much modified by conditions other than mechanical, and by what may be called the personal equation.

This question presented itself to Mr. Taylor 26 years ago, when a young machine-shop foreman, in Philadelphia. Its answer has taken all the intervening time and to it have been devoted the best energies not only of Mr. Taylor, but of others, expert mathematicians and engineers. Many thousands of dollars have been expended upon experiments made in the attempt to completely answer this apparently simple question and those who spent the money have been the gainers by it.

It has not been completely answered yet and perhaps never will be, but the answer and the way to get a specific answer in a given case has been taken out of the rule of thumb realm and reduced to an exact science, so that, given a specified amount of metal to be removed from a specified piece of work in a specified lathe, the very best combination of speed, feed, depth of cut, etc., for that particular job can be at once determined by the setting of a few slides on a specialized slide rule, and the difference between the answer so obtained and the one that will be given by the average machinist to the same question is usually astounding. Some years ago Mr. Taylor gave, before a meeting of the society, the results of his experiments with belts used to drive machine tools. Though this was only a small section of the work being carried on it was clear at

the time that the author, taking nothing for granted, had upset the accepted rules for belts, and put new ones in their places. So it has been with many other things, the work reminding one of the large canvasses of the old masters which are commonly reproduced in sections, each section or figure being by itself a masterpiece.

That such work as has been carried on by Mr. Taylor and his associates could have been prosecuted for 26 years, and that it could have been producing such remarkable results as it has produced—results known to a good many people, and yet escape being generally known, is one of the most remarkable features of the case. With Mr. Taylor's expressed opinion that such secrets could not have been as well kept in any other country we find ourselves unable to agree, however. Shop men and engineers of other countries have not shown themselves less able to keep secrets than ourselves, but rather better, and the sense of honor among them is just as high. Success in this point must we think be attributed to the influence of Mr. Taylor's own personality, and to care in the selection of those intrusted with participation in the work.

Foreigners at Sandy Hook

More or less sensational reports have appeared in the daily press regarding the exclusion from the Sandy Hook defenses of seven foreigners who went down on the train as guests of various members of the A. S. M. E., expecting to accompany the members upon their trip of inspection. The society has been charged with having taken action resulting in an embarrassing situation for these guests.

As a matter of fact the society took no action whatever with regard to it, nor did any officer representing the society do so. When it was found that certain foreigners, including men who were citizens of England, France, Germany, Canada and Japan were on the train it was thought to be no more than fair to the officers in charge to apprise them of this fact so that they might take such action as the regulations prescribed, and any misunderstanding between them and the society or with the military authorities at Washington be avoided.

Being apprised of the facts the officers promptly decided that only American citizens could be admitted to the fort, although an officer detailed for the purpose showed the foreigners all that could properly be shown them, and extended to them every possible courtesy. In fact, the action involved no criticism of the visitors, and in no way implied any charge against them or the least suspicion that they had accompanied the members from any improper motive. It was simply and only a case of observing the military regulations for which no one present, either officer or visitor, was in the least responsible. It is, of course, much to be regretted that the possibility of such action was not foreseen, but certainly no one was particularly to blame for not having done so. In fact the possible presence of foreigners with the excursion had not occurred to anyone until they were seen upon the train.

Henry J. Hendey

Last week we briefly announced the death, at his home in Torrington, Conn., December 8, of Henry J. Hendey, president of the Hendey Machine Company. Mr. Hendey had been ill for several weeks, his principal ailment being nervous exhaustion. He was born in London, December 29, 1844, and when four years of age came to this country with his father. The family located in Waterbury, Conn., where Mr. Hendey grew to manhood, learned the machinist trade, and in 1865

HENRY J. HENDEY

removed to Torrington, where he at first worked at the trade and afterward (July, 1870) with his brother Arthur, commenced business in a small shop. Their motive power was a small engine which Mr. Hendey had built by way of amusement in his leisure time; the business soon outgrew this, but Mr. Hendey always kept the engine as a memento of earlier days. Finally, in 1874 the business was incorporated with a capital stock of $16,000 and though it had been growing under the able management of Mr. Hendey, it came into special prominence as a result of his foresight and shrewdness in perceiving the advantage of the device of Mr. Norton, and of securing his coöperation in the management of the business. Today about 600 men are employed, and the capital stock of the company is about $300 000, the Hendey-Norton lathe being known all over the world where good work is done.

Mr. Hendey was the first warden of the borough of Torrington, and also served as a burgess. In 1903 he was a member of the Connecticut legislature, where he was a member of its committee on manufactures. Mr. Hendey inspired confidence in all with whom he came in contact. He was conscientious in the performance of every duty, and was universally respected by all who knew him. Of late years Mr. Norton in the mechanical end of the business, C. H. Alvord, secretary, and Mr. Fuessenich, treasurer, have been relieving Mr. Hendey, and the business built up under his guidance will go on as before.

National Society for the Promotion of Industrial Education

A meeting of the board of managers of the National Society for the Promotion of Industrial Education was held in the office of the Carnegie Foundation, New York City, December 8, at which meeting Prof. C. R. Richards, of New York, was elected secretary, and Prof. M. P. Higgins, of Worcester; Charles A. Moore, of New York; Samuel B. Donnelly, general secretary of the Building Trades Arbitration Board of New York; Mrs. Mary Morton Kehew, of Boston, president of the Woman's Industrial Educational Alliance, and member of the Massachusetts Industrial Educational Commission, and Dr. James P. Haney, supervisor of manual training in the schools of Manhattan and the Bronx, New York City, were elected members of the executive committee. These, with the officers of the society, Dr. Henry S. Pritchett, president; M. W. Alexander, vice-president; V. Everit Macy, treasurer, and C. R. Richards, secretary, constitute the executive board, which also held a meeting immediately, at which various committees were appointed to have charge of the various lines of work and of investigation to be carried on by the society.

Canadian Plant for Billings & Spencer

The announcement is made that the Billings & Spencer Company, of Hartford, Conn., has decided to open a Canadian branch for the manufacture of drop forgings and drop-forging machinery, and has incorporated under the name of the Canadian Billings & Spencer Company, Limited, with F. C. Billings as president. The capital of the Canadian company is $200,000. The concern will be the first in Canada in this line of business, and it will make a specialty of auto and bicycle parts. The location of the plant has not been decided upon. The manager of the new plant, it is announced, will be J. Gill Gardner, of Brockville, Ont., and a special effort will be made by his town to get the new concern to locate there.

Warner and Swasey as Amateur Lecturers

W. R. Warner and Ambrose Swasey having both recently been abroad on trips of observation and recreation, it was suggested to them that the men employed in their shops in Cleveland would appreciate an opportunity to hear some description of what they had seen and heard on these trips. Accordingly a room in the new addition to the shops was supplied with seats, fitted with a screen for showing lantern slides and, on the evening of November 24, Mr. Swasey spoke to an audience of about 1100 employees and members of their families. Beginning at San Francisco the speaker took his audience to Honolulu, Japan, the Philippine Islands, Ceylon and other most interesting places, exhibiting, besides the lantern slides, many souvenirs of his travels, in the gathering of which Mr. Swasey is an expert and acquires only those things that are worth while.

The following Monday Mr. Warner was the speaker, and described his travels upon the Nile, in Palestine, Turkey and Greece. The two addresses taken together constituted what was referred to as "Around the World in Two Evenings," and needless to say were very much enjoyed and appreciated.

The Technical Publicity Association held a meeting Thursday evening, November 22, at the rooms of the Aldine Association, New York, and heard the report of its circulation committee, consisting of H. M. Davis, of the Sprague Electric Company; C. N. Manfred, of the H. W. Johns-Manville Company, and Paul M. Wade, of the Standard Paint Company. The committee submitted a plan by which the association will collect information about trade and technical magazines, which will be treated confidentially and be used by T. P. A. members only.

The United States Civil Service Commission announces an examination on January 9-10-11, 1907, to secure eligibles from which to make certification to fill at least ten vacancies in the position of mechanical draftsman, at from $1000 to $1200 per annum. Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application Form 1312. In applying for this examination the exact title—Mechanical Draftsman, Quartermaster's Department at Large, Jan. 9-10-11, 1907—should be used in the application.

For experimental screw spikes being tried on the Pennsylvania Railroad on 100-pound rail, a threaded hole is bored in the tie and a steel helix placed in it; the spike is screwed in, its thread cutting into the wood between the steel helix. Flat tie plates without claws are used.

NEW TOOLS AND MACHINE SHOP APPLIANCES

PEN-FILLING INKSTAND

The illustrations show a very handy inkstand designed for use on the drawing board, this appliance being so constructed as to allow the draftsman to fill his pen by using the pen hand alone, leaving the other hand at liberty to hold the T-square, triangle, etc., as the occasion requires. Fig. 1 gives a good idea of the proportions of the inkstand; Fig. 2 shows the method of

FIG. 1. PEN-FILLING INKSTAND

filling the pen; Fig. 3 is a larger view of the dipper. The weight of the stand is sufficient to provide a stable base for the ink bottle, and the shallow seat and spring clip are adapted to receive and hold securely the standard bottle now in general use, the stopper and quill of course being discarded when the bottle is put in place. In filling the pen the hand is placed on the rest at the end of the lever, elevating the

FIG. 2. FILLING THE PEN

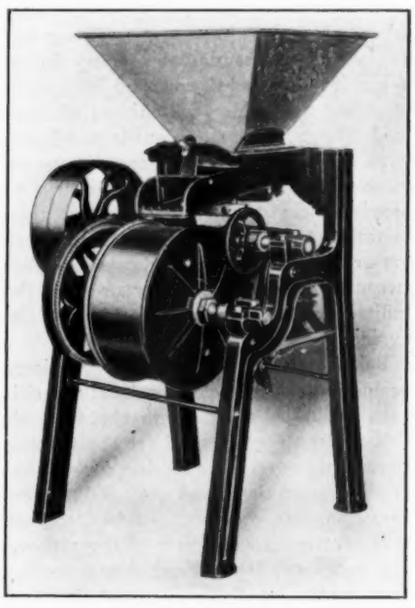
dipper to full hight and the pen raised until the dipper loop is between the blades. The loop then touching the inside of the blades instantly delivers an ample and uniform charge with no tendency whatever to ink the outside of the pen. Upon removing the hand the rubber cap descends and automatically closes the bottle to prevent evaporation, entrance of dirt, etc. The stem has three grooves for holding the cap and the latter may be shifted to a lower groove if it is found upon inserting a fresh bottle that the dipper is touching bottom, or if it is picking up sediment at any time. The loop at the bottom of the dipper as now made is flattened so that

FIG. 3. THE DIPPER AND STOPPER

it may be entered between the blades quite near the points. This inkstand is made by Theo. Alteneder & Sons, Philadelphia, Penn., and from personal use of it we can say that is seems to be all that could be desired.

A MAGNETIC SEPARATOR

This machine is for separating iron from brass and other non-magnetic substances. It is an improved form of the



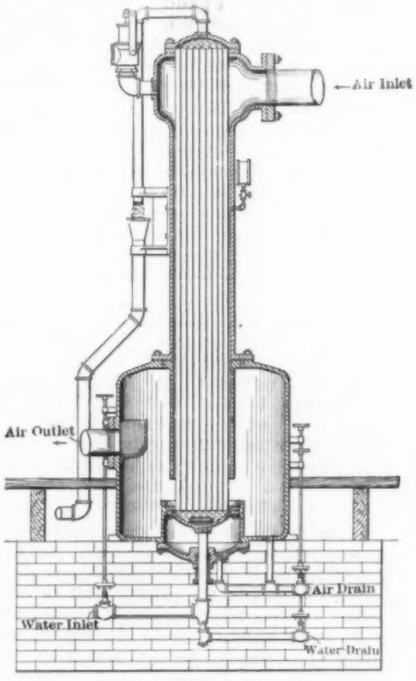
A MAGNETIC SEPARATOR

Sawyer separator. It consists of a drum in which are imbedded a large number of horseshoe magnets. The drum is covered

with a casing of sheet brass which is easily replaced when worn out. The material to be separated is put in hopper at the top of the machine and as the drum turns it is distributed over its face. The non-magnetic particles fall into a receptacle under the machine, while the iron adheres to the drum and is carried around to the back where a brush removes it into a trough. This machine is built by Charles T. Burlin, Whitinsville, Mass.

VERTICAL INTERCOOLER FOR AIR COMPRESSORS

The illustration shows the latest and standard vertical intercooler—used also as an antecooler and an aftercooler—of the Ingersoll-Rand Company. Referring to the illustration, the air enters at the top, strikes across and among the thin brass cooling tubes and passes down the body, with only space sufficient for its free passage, with intimate contact with all the tubes. The size of the shell is continued by a petticoat down into the large settling chamber and the air leaves the tubes near the bottom, circulates slowly around, drops its liberated water and passes out by the upward-looking elbow at the side. The water enters at the bottom and overflows at the top, keeping the tubes always full and avoiding all pressure except that due to the weight of the water, so that the tubes are very thin and highly efficient for their purpose. The upper head in which

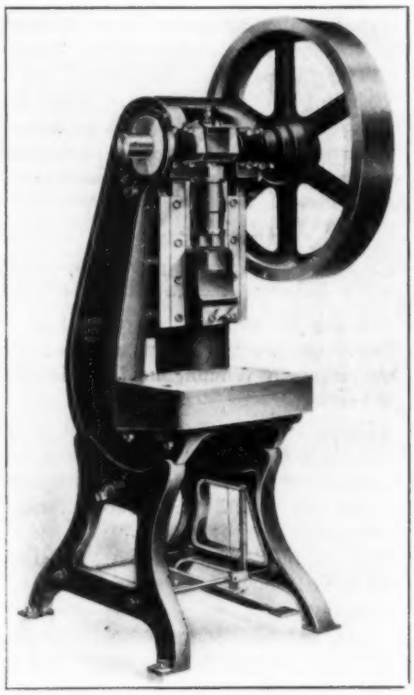


SECTION OF VERTICAL INTERCOOLER WITH CONNECTIONS AND APPURTENANCES

the tubes are fastened is held securely by the cap bolted over it; the lower tube head being free to slide vertically to avoid all strains of expansion or contraction, the water pipe being led in through a stuffing box. The tubes may be taken out without moving the body and if the joint is broken at the top of the settling chamber not much hight is required for the lift. The capacity of the lower chamber gives it considerable value as an air receiver, although it is not intended that the usual air receiver shall be dispensed with.

AN INCLINABLE POWER PRESS

The illustration shows an inclinable power press, weighing 2200 pounds, representative of a line of eleven sizes ranging in weight from 750 to 6500



INCLINABLE POWER PRESS

pounds. These presses are furnished with any one of a number of clutches; a positive stop which prevents the crank shaft making a second revolution; the press can, however, be run continuously if so desired by throwing the positive stop out of engagement. A treadle lock is supplied with each press and also a positive knockout for discharging work from the upper die. All adjusting nuts are case-hardened.

These presses are built by the Standard Machinery Company, Providence, Rhode Island.

A DOUBLE SWIVEL VISE

This vise can be fastened at any angle. It is fastened or released with one operation of the lever and there are no pins, bolts or other locking devices on it to interfere with the mechanic while working. It is called the Reed patent vise and is manufactured by the Fulton Machine and Vise Company, Lowville, N.Y.

Alfredo Prince, Casilla 571, Valparaiso, Chile, sends us some photographs showing the destructive effects of the recent earthquake and fire in that city upon certain machine shops, and he states that as a result of this catastrophe he lost all his tools and equipment and a twelve-year collection of the AMERICAN MACHINIST, which he says he prized very highly. Mr. Prince, however, bravely declares he will start over again and would be glad to have catalogs with prices of machinists' small tools.

New Publications

"Report of the Proceedings of the Fourteenth Annual Convention of the International Railroad Master Blacksmiths' Association." 203 5½x8½-inch pages. Published by the secretary, Lima, Ohio.

The annual appearance of the Proceedings of the Railroad Master Blacksmiths' Association shows the association to be a thoroughly live one. Not much of the work done is of large interest outside of railroad circles, but within those circles it must be the means of the dissemination of much useful information.

"Practical Lettering With Original System for Spacing." By Thos. F. Meinhardt. Fifteen 14x9-inch pages with 3 full-page plates. The Norman W. Henley Publishing Company, New York. Price 50 cents.

The object of this pamphlet is to explain a system which the author has developed for so spacing letters as to produce a uniform optical effect, the overhang of such letters as W and P and the under-projection of such letters as A and L being overcome. While the system proposed is mechanical, it is expected by the author that its intelligent application will result in training the eye until letters are grouped with correct optical spaces by force of habit. An outgrowth of the system is the fact that by it the exact length of an inscription may be determined before the work is started, the exact spot where the first letter begins and the last one ends, with even margins, being determined beforehand. For lettering of a character which demands attention to this point, the method described impresses us as useful and worthy of attention.

"Reinforced Concrete," by Albert W. Buel and Charles F. Hill. Second edition, 499 6x9-inch pages, with 348 illustrations. The Engineering News Publishing Company, New York, price $5.

This treatise is divided into three well-defined parts, of which the first treats of the methods of calculating reinforced concrete construction, the second gives representative examples of work, and the third shows various methods of construction. The second part includes examples of foundation, building, bridge and culvert, conduit, tank and reservoir, retaining wall, dam and chimney construction. Three appendices give the results of tests at the University of Illinois, and at the Watertown Arsenal, and R. T. Dana's method of

proportioning the ingredients in Portland cement concrete. The second edition is the outgrowth of an unexpected demand for the first and includes many revisions and enlargements, among them being the appendices mentioned above. The rapidly extending use of reinforced concrete makes the book an extremely timely, as it is a thoroughly satisfactory, treatise on the subject.

We are in receipt of a copy of the *American Wire Rope News*, published by the American Steel Wire Company, the Rookery, Chicago. This number contains twelve 8½x11½-in. pages, and is well printed and illustrated and contains some matter of very general interest. Some clear illustrations show the results of improper methods of splicing thimbles into wire rope and also show the correct methods; similar comparisons are made in the case of the application of Crosby clips and in the running of wire rope around sheaves. In the case of the former the short end of the rope which is brought around the thimble or anchorage should rest in the crown of the U bolt, the main rope being in the bottom of the casting or nearest to the nuts. In running wire rope around sheaves the making of reverse bends in the rope should be avoided if possible. Another article illustrates the increase in the stress in a cableway due to small sag in the span. Diagrams are given showing the proportionate pull in a rope with different arrangements of pulleys, and a diagram of a derrick showing the arrangement of the rope around the different sheaves. The standard constructions of the wire rope made by this company are shown by a series of exceedingly clear cross-sections and side views; the use of wire rope in stump pulling, and other subjects are also briefly treated of.

Personal

Will our friend who signs himself "Nadir" kindly send name and address to the editor?

H. A. Flagg has been appointed manager of sales of the Shelby Steel Tube Company, and will be in charge of their New York office.

H. Crocheron has opened a drafting office at room 807, Montauk Building, Liberty street, New York City, and will make a specialty of patent-office drawings, trade marks, etc.

C. W. Putnam has resigned as foreman of the General Vehicle Company, of Long Island City, N. Y., and will take the position of foreman for the Julian Keller Company, of Philadelphia.

Henry R. Towne, president of the Yale & Towne Manufacturing Company, Stamford, Conn., was recently presented with a silver loving cup, by the superintendents and foremen of the works.

J. F. Buckley, formerly superintendent of the works of J. Thompson & Sons Company, Beloit, Wis., is now connected with the steam pump department of Fairbanks, Morse & Company of the same city.

Roy V. Myers, until recently chief engineer and superintendent of mines for the Dayton Coal and Iron Company, Ltd., Dayton, Tenn., and William Whaley, until a year ago mechanical engineer and draftsman for the La Follette Coal, Iron and Railway Company, La Follette, Tenn., have organized the engineering firm of Myers & Whaley, with offices in the Empire Building, Knoxville. The firm will act as consulting engineers, prepare plans and estimates for the development of mineral properties, the construction of mechanical, civil and mining engineering works, and make surveys, maps, etc.

Obituary

George W. Remington, president of the Remington Machine Company, died December 11, in Wilmington, Del. He was 67 years old.

Henry Herman Clark, president of the Aetna Nut Company, and Clark Bros. Bolt Company, died December 4, at his home, in Milldale, Conn., after a short illness of pneumonia, aged 77 years. Mr. Clark had been identified with his two brothers in the manufacture of bolts and other hardware since 1854.

John Madison Keith, master mechanic at Empire, on the Panama canal, died December 9 at the home of his daughter, in Kansas City, aged 75 years. Two years ago he was bitten by a centipede on the neck. A growth penetrated the tissues, and he went to Philadelphia six months ago for an operation before going to Kansas City. Mr. Keith was born at Xenia, Ohio, and was widely known in Central America as an engineer.

Fitzhugh Townsend, instructor in electrical engineering at Columbia University, died of typhoid fever, December 11. He had been connected with the electrical engineering department as assistant, tutor, and instructor since 1897. For the last few years he had been interested in the development of a new railway signal device he had invented. This system will be installed on several large railways, among them the New York Central. He was joint author with Prof. George F. Sever of a work on "Laboratory and Factory Tests in Electrical Engineering."

Rear Admiral Peter C. Asserson, civil engineer of the United States Navy, who for fifteen years prior to his retirement in 1901 was in charge of the Department of Docks and Yards at the Brooklyn navy yard, died, December 6, of heart failure at his home in Brooklyn. He was 66 years old. In 1862 he entered the navy as a mate and was soon made an acting engineer, in which grade he served until the close of the Civil War. Retiring then to private life he took up the study of civil engineering. In 1874 he reëntered the navy as an engineer, and after nine years at the Norfolk navy yard he was transferred to the navy yard at Brooklyn. He was considered an authority on dry-dock construction.

Business Items

The firm of Hill, Clarke & Co. has been dissolved and the business will be carried on in future under the name of Hill, Clarke & Co., Incorporated, at 156 Oliver street, Boston, Massachusetts.

The Franklin Moore Company, of Winsted, Conn., advises us that it has commenced operations in its new foundry, where it will manufacture light gray-iron castings and small brass castings of a high order.

Edwin E. Bartlett, Boston, Mass., manufacturer of the Greenerd arbor press, has been compelled to move into larger quarters, owing to increased business, and his new factory is located at 328 A street, Boston. This new plant will enable him to greatly increase his production and make prompt deliveries.

The Boston Gear Works have discontinued their Boston office and all business will hereafter be transacted from Norfolk Downs, Mass., where their factory and offices are located. Their plant has been greatly enlarged and they are in better position to take care of the increased volume of business.

The Hess-Bright Manufacturing Company has found it necessary, on account of increasing business, to secure larger quarters for its local manufacturer of H-B ball bearings, as well as for the shipment of its imported D. W. F. ball bearings. The new location is corner Nineteenth and Hamilton streets, Philadelphia.

The Buffalo Forge Company has recently received an order through its London office for its large steel-plate fans, with self-alining bearings and built of extra heavy material, for use in a heating and ventilating system for the shops of one of the Belgian States railways. The order also included four heavy down-draft forges, which will weigh in aggregate 3000 pounds.

The Millalsin Engineering and Foundry Company, recently organized in Sharon, Pa., with F. Millhouse, president; J. Sinclair, secretary and treasurer; E. Allen, manager; has its new building well under way and hopes to be ready for business by January 1. It will do a general machine and foundry business, with a specialty of high-grade bronze castings, jigs, fixtures, etc., for ordnance work.

Prices in the electrical trade continue to show a distinct upward tendency, in sympathy with the well maintained advance which has taken place in the prices of all raw materials. Orders for future delivery can only be placed in many instances at a considerable advance over present market quotations. The General Electric Company, in common with many other large manufacturing concerns, is announcing a general advance in prices of electrical apparatus and supplies. This will not unlikely be followed by further advances if present market conditions continue.

Manufacturers

The Schurmeier Wagon Company, St. Paul, Minn., will erect a new plant.

The American Candy Company, Milwaukee, Wis., will erect a new factory.

The Pacific Ice and Cold Storage Company, Reno, Nev., will erect a plant.

The Marine Iron Works, Portland, Oregon, will double the size of its plant.

The Simon Packing Company, Youngstown, Ohio, will erect a large packing pant.

The Fort Hill Bronze Company, Boston, Mass., is erecting a factory at Everett.

The Red Cliff (Wis.) Lumber Company will build a new sawmill, to cost $40,000.

The Mechanical Rubber Company, Cleveland, Ohio, will build a two-story addition.

The Shawmut (Me.) Manufacturing Company will erect a large paper and pulp mill.

The Marine Metal and Supply Company, of New York, will erect a factory in Jersey City.

The New Haven (Conn.) Water Company will erect a new boiler house in Whitneyville.

The Schaake Machine Works, New Westminster, B. C., is contemplating enlarging its plant.

The city of Pierre, S. D., has raised the required funds for a municipal electric-lighting plant.

The Benton Harbor (Mich.) Malleable Iron Foundry, recently organized, will erect a plant.

The Sioux Falls (S. D.) Metal Culvert Company, a new concern, is having a factory erected.

The Omaha (Neb.) Electric Light and Power Company will erect a new $10,000 power substation.

The Contractors' Casting and Machine Company, Buffalo, N. Y., has filed plans for a new foundry.

The Philadelphia (Pa.) Electrical Manufacturing Company has bought site for a new factory.

The Midvale Steel Company, Nicetown, Pa., will erect a one-story steel-frame shop at its plant.

The Chatham Manufacturing Company, Elkin, N. C., will erect a woolen mill in Winston, N. C.

A. Weiskettle & Son, stove manufacturers, Baltimore, Md., are building an addition to their foundry.

The plant of the Star Glass Company, at Randall, W. Va., was destroyed by fire. It will be rebuilt.

The Northern Automobile Company, of Detroit, Mich., will establish a branch factory in Port Huron.

The Stephen Bilek Company, Chicago, Ill., manufacturing moldings, will erect a new $12,000 factory.

The Chickasaw Iron Works, Memphis, Tenn., will erect a $40,000 branch plant in North Memphis.

The Field-Brundage Company, Jackson, Mich., manufacturing gas engines, is erecting another addition.

Four new factory buildings will be erected for the Union Metallic Cartridge Company, of Bridgeport, Conn.

The Brooklyn (N. Y.) Cold Storage Company has completed plans for a $225,000 addition to its plant.

The Wilmot Castle Company, Rochester, N. Y., will erect a plant for the manufacture of sheet-metal goods.

A new engine and power-house will be erected for the Crown Cork and Seal Company, Baltimore, Md.

The Rowley Lead Company, St. Louis, Mo., will move to Detroit, Mich., where a large plant will be erected.

The New York Belting and Packing Company will erect another four-story mill at its plant in Passaic, N. J.

The Suffolk (Va.) Packing Company has selected a site for its plant. J. Walter Hosier, of Suffolk, is one of the officers.

The E. W. Bliss Company, Brooklyn, N. Y., will erect a six-story annex to its forge shops and enlarge the present structure.

Plans are being drawn for a new building at the plant of the Waterbury (Conn.) Brass Company, to be used as a casting shop.

Frank Wheeler & Son, Meriden, Conn., manufacturers of power presses, are considering the erection of an addition to their plant.

The Woven Wire Fence Company, Anderson, Ind., will erect a plant in Coffeyville, Kas., which will consist of four buildings.

The E. Godel & Sons Packing Company, Peoria, Ill., will build a $40,000 addition, in which will be included a cold-storage plant.

The Miehle Printing Press and Manufacturing Company, Chicago, Ill., is reported to have bought a site on which a $500,000 plant will be erected.

The Sperich & Morgan Packing Company has been organized at Rialto, Cal. A plant will be erected. A. H. Morgan, of Rialto, is one of the organizers.

The Berbecker & Rowland Manufacturing Company, Waterville, Conn., making brass specialties, etc., will put up a new factory building at its plant.

The Gilsen Manufacturing Company, Port Washington, Wis., manufacturing gasolene engines, office-chair irons, etc., will establish a plant in Guelph, Ont.

The H. Wetter Manufacturing Company, South Pittsburg, Tenn., will erect an addition to its stove foundry, which will be used for casting soil pipe and fittings.

The Self-Threading Needle Company, Minneapolis, Minn., a new concern with offices at 709 Andrus building, has had plans prepared for its factory buildings.

The main factory building of the H. C. Thompson Clock Company, Bristol, Conn., was damaged by fire, entailing a loss of $10,000. It will be rebuilt at once.

Catalogs

Sprague Electric Company, 527-531 West 34th street, New York. Flyer No. 225, illustrating electric hoists and cranes.

Charles Ross & Son Co., 148-156 Classon avenue, Brooklyn, N. Y. Catalog No. 5 of paint machinery. Illustrated, 64 pages, 6x9 inches, paper.

Saxon Machine Co., Holyoke, Mass. Circulars illustrating and describing Nos. 2 and 3 surface grinders and cylinder grinder with boring attachment.

Armstrong-Blum Manufacturing Co., 104-124 North Francisco avenue, Chicago, Ill. Folder illustrating and describing Marvel punches and shears.

Niles-Bement-Pond Co., 111 Broadway, N.Y. Catalog describing Tindel high-duty saw blades and high-duty cold sawing machines. Illustrated, 46 pages, 6x9 inches, paper.

Rock River Machine Co., Janesville, Wis. Catalog C describing machine tools for working plates, bars and structural material. Illustrated, 42 pages, 6x9 inches, paper.

The Baker Machine Corporation, New Bedford, Mass. Booklet, entitled "For the Man with Turret-Lathe Work and No Turret Lathe," and which describes the turret head made by this company. Illustrated, 8 pages, 3½x6 inches, paper.

The Orleans Metal Bed Company, New Orleans, La., is being organized with a capital of $75,000. This is a merger of three metal-bed concerns, and the president is Col. J. M. Sherrouse. What is to be one of the largest metal-bed factories in the South will be built.

Ingersoll-Rand Co., 11 Broadway, New York. Catalog, form X 36, describing Rand "Imperial" type ten air compressors. Illustrated, 6x9 inches, 40 pages, paper. Bulletin No. 2008, on "Imperial" motor hoists and stationary motors. Illustrated, 6x9 inches, 32 pages, paper.

Patterson, Gottfried & Hunter, Ltd., 146-150 Center street, New York. Booklet calling attention to the fact that this concern is distributing agent for the emery wheels of the Abrasive Material Company, also to line of grinding and polishing machinery. Illustrated, 3½x6 inches.

Emerson Electric Manufacturing Co., St. Louis, Mo. Bulletin No. 3205 on bipolar ventilated motors, 1/16 to ⅛ h.p., for direct current. Illustrated. Bulletin No. 3206, bipolar inclosed motors. Illustrated. Bulletin No. 3303, direct-connected volume blowers for direct and alternating currents. Illustrated.

The Norton Grinding Company, Worcester, Mass., is building an addition to its plant, which is to be used as an office and storage building, and when completed will of course afford additional room within the shop proper for manufacturing operations made necessary by the growing demand for grinding machines.

J. G. White & Company, New York, have been appointed by the Government to draw new plans and specifications and assist the Federal engineers in the selection of designs for the new power plant at the Congressional buildings in Washington. The new plant will have a capacity of 14,000 horsepower.

Miscellaneous Wants

Advertisements will be inserted under this head at 25 cents a line each insertion. Copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded.

Caliper cat. free. E. G. Smith Co., Columbia, Pa.

Cox Computers. 75 Broad St., New York.

Universal Test Indicator circulars free. H. A. Lowe, Lock Box 146, Cleveland, O.

Steel case-hardened by modern methods. Boston Gear Works, Norfolk Downs, Mass.

Will buy or pay royalty for good patented machine or tool. Box 282, AMER. MACHINIST.

Light, fine machry. to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Dies and Diemaking, $1.00. A shop book by a shop man. J. L. Lucas, Bridgeport, Ct.

Novelty in tool or machine specialty wanted. Particulars required. Box 202, AMER. MACH.

Special machinery designed and built. Walter S. McKinney, M. E., 43 Broadway, Flushing, N. Y.

Electrical apparatus designed and built. Geo. M. Mayer, M. E., 1131 Monadnock Block, Chicago, Ill.

Gas engines designed to order. Marine and automobile work a specialty. H. L. Towle, 150 Nassau street, New York.

Special machinery accurately built. Screw machine and turret-lathe work solicited. Robt. J. Emory & Co., Newark, N. J.

Wanted—Contracts or orders for gray-iron castings; medium and light weight a specialty. Address "L. M. N.," AMER. MACHINIST.

Wanted — Medium weight specialties to build, or will buy or pay royalty for good patented machine or tool. Box 424, AM. MACH.

Estimates given on machine work, patterns and designing in all branches. Address Greenfield Steam Engine Works, Harrison, New Jersey.

Wanted—Partner, willing to invest capital, to take half interest in established engineering specialty and consulting engineering business. Box 431, AMERICAN MACHINIST.

Special machinery and duplicate machine parts built to order; tools, jigs and experimental work; complete modern equipment. MacCordy Mfg. Co., Amsterdam, N. Y.

Technical men everywhere in spare time. No goods to sell; no expense; professors, draftsmen and literary machinists thus far appointed; state experience. Box 334, AM. M.

A large English firm of machine-tool importers, having showrooms and offices in Great Britain, France, Italy and Japan, is wanting good agencies for machine tools of all kinds. Apply Box 189, AMERICAN MACHINIST.

Contract work — A large, well equipped

foundry and machine shop in Ohio is open for contract work; moderately heavy work preferred, such as machine tools, engines, compressors, or any special machinery. Address Box 370, AMERICAN MACHINIST.

Mechanical engineer, patentee, designer of latest types of motor cars for English manufacturers, desires negotiating with capitalist or engineering firm for establishing motor-car works in United States. Drawings ready; could start at once. Box 429, AMER. MACH.

Tool catalog No. 22, 950 pages bound in cloth. Greatest small-tool catalog ever published. Will be sent post-paid on receipt of $1. Money paid for catalog refunded with first purchase amounting to $10 or over. Book costs you nothing if you become a customer. Montgomery & Co., 109 Fulton street, New York City.

The annual meeting of the stockholders of the Hill Publishing Company, for the election of five directors for the ensuing year and for the transaction of such other business as may properly come before the meeting, will be held at the office of the company in the Hallenbeck Building, 497-505 Pearl street, Borough of Manhattan, New York City, N. Y., on Monday, January 14, 1907, at 12 o'clock noon.

Dated, New York City, Dec. 17, 1906.

F. R. LOW, Secretary.

We have a modern up-to-date manufacturing plant and, having recently more than doubled our capacity, are in a position to take contracts for the manufacture of special tools, small high-grade machinery, or parts of machines in large or small quantities; we can refer to a very well known line of high-grade tools now on the market to demonstrate that we are able to do the highest grade of interchangeable work. Will be pleased to furnish estimates upon receipt of drawings and specifications. Box 363, AM. M.

Wanted—A thoroughly practical and up-to-date foundryman who can invest $20,000 to $25,000 in a modern foundry, and who can manage same himself. Have a good proposition in the middle West. There are three machine shops and a railroad shop in close proximity whose long established trade can be obtained, and who use medium and heavy castings of high grade weighing from 1 lb. to 20,000 lbs. No other foundry within 40 miles. Present plant unable to supply demand and has been turning away a large amount of business for several years. This proposition will bear the closest investigation and correspondents must furnish reference. It is also straight business and no promoters need answer. Box 428, AMERICAN MACHINIST.

Business Opportunities

Wanted to contract with shop within 50 miles of New York City, equipped for making highest grade automobile chassis. Must have capacity for at least 100 cars per year and able to do highest grade interchangeable work cheaply. No body work. Box 210, AM. MACH.

We can build machinery for quick delivery. A shop building machine tools wishes to take contracts for the construction of machinery or anything that can be produced in a foundry and machine shop. Send drawings and specifications and estimates will be made with guarantee of quick delivery. We can refer to a standard line of tools now on the market as to the quality of workmanship. Box 75, AMERICAN MACHINIST.

For Sale

For Sale—Foundry, wood and iron machine shop. Box 74, Albion, N. Y.

For Sale—Two second-hand cupolas in first-class condition; shells 72"—82" in diameter and about 40 feet high. Box 333, AM. MACH.

For Sale—Gear cutter; light foot or power gear cutter with 24 cutters, suitable for model or clock maker. J. McLaughlin, 326 Market street, St. Louis, Mo.

Foundry and machine shop for sale, with good will, in the northeastern part of Philadelphia; plant now running and is complete with core shop, engine, rattlers and cupola, with capacity for 5-ton heats; area of property 12,000 sq. ft.; streets on two sides; good local jobbing trade; owners consolidating plants elsewhere. Full particulars may be obtained by addressing Box 380, AM. MACH.

For Sale—Foundry and machine shop located in Red Wing, Minn., a manufacturing town of about 9000 inhabitants. The business has been established for over 40 years and has always been profitable. The present owners desire to retire on account of age. An excellent opportunity for a practical machinist who has some knowledge of foundry work, with about $5000 capital. The balance of money needed will be furnished by other manufacturing interests. Only an experienced man with capital will be considered. Address E. S. Hoyt, Red Wing, Minn.

Wants

Situations and help advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Friday for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded, but replies will not be returned. If not forwarded, they will be destroyed without notice. Original letters of recommendation or other papers of value should not be enclosed to unknown correspondents. Only bona fide situation want or help want advertisements inserted under this heading. Agency advertisements must be placed under Miscellaneous Wants.

Situations Wanted

Classification indicates present address of advertiser, nothing else.

CONNECTICUT

Wanted—A responsible position by a technical graduate (37); twenty years' experience as toolmaker, foreman, designer and superintendent on fine and medium interchangeable work; A-1 references by past and present employers; any location. Box 426, AM. MACH.

GEORGIA

Position as superintendent or general foreman on engines, air compressors and electrical machinery. Box 432, AMER. MACHINIST.

ILLINOIS

Mechanical superintendent or general foreman desires change (Eastern section preferred) by Eastern man who produces results. Box 427, AMERICAN MACHINIST.

INDIANA

Technical graduate, all-around mechanic, A-1 jig, tool and fixture designer; road experience; can handle men to advantage and reduce shop costs; 13 years' experience; employed at present, but desires change after Jan. 1; middle West preferred. Box 423, AMERICAN MACHINIST.

IOWA

Mechanical engineer wants to get charge of a line of work with good people; $1600. Box 387, AMERICAN MACHINIST.

MICHIGAN

Superintendent wishes to make a change; experienced in the commercial manufacturing of both small and medium machinery with the interchangeable system; a systematizer and cost reducer; have held the following positions: toolmaker, tool designer, foreman and master mechanic; willing to go anywhere; New England preferred. Address Box 403, AMERICAN MACHINIST.

MISSOURI

Manager or shop superintendent; 23 years' experience, technical education, good executive ability, strictly up-to-date on shop organization and management; guarantee reduction of costs. Box 416, AMER. MACH.

NEW JERSEY

Salesman—A position as salesman for machinery and machinery specialties; 15 years' experience; age 35. Box 441, AM. MACH.

Position as designer on internal-combustion engines; technical graduate; seven years' shop and drafting experience. Address Box 444, AMERICAN MACHINIST.

General foreman in large shop desires position as superintendent or master mechanic; technically educated and strictly up-to-date. Box 430, AMERICAN MACHINIST.

General foreman—Ten years in official capacity on high-grade work; experienced in the design and construction of jigs, fixtures and tools. Box 439, AMERICAN MACHINIST.

Experienced toolroom foreman, capable of designing tools, jigs, fixtures, automatic and semi-automatic machinery for the production of small interchangeable parts; age 37; salary $1800. Box 443, AMER. MACHINIST.

NEW YORK

Wanted—Position as chief draftsman or assistant superintendent. Box 442, AM. MACH.

Mechanical engineer, competent, experienced man, with some capital, seeks business opportunity. Box 302, AMERICAN MACHINIST.

General foreman and master mechanic, age 37; successful manufacturing high-grade duplicate and special machinery at lowest cost; natural executive. Box 434, AMER. MACH.

Designing draftsman—educated and experienced in leading positions, both shop and drafting room — wishes permanent position with growing firm; first-class references. Box 437, AMERICAN MACHINIST.

Situation wanted—General manager of machine shop and foundry will make change March 1; fifteen years' experience cost clerk, buyer and manager; A-1 record. Address Box 418, AMERICAN MACHINIST.

Position as manager of works by mechanical engineer; held similar positions past six years in large modern plants; high standing in executive and mechanical ability, experience and energy; irreproachable character; good reason for change. Address Box 425, AM. M.

Position as works manager with company employing about 200 men; am desirous of associating with a company that wants to cut the cost of manufacture and increase their output; excellent executive ability, successful in the handling of men. Box 374, AM. MACH.

WISCONSIN

Position as superintendent or equipment engineer; young man with A-1 record, good executive and business abilities; if not willing to pay for high-class man, don't answer. Box 433, AMERICAN MACHINIST.

Help Wanted

Classification indicates present address of advertiser, nothing else.

CANADA

Wanted — Draftsman with experience in sawmill and pulp machinery; state age, experience and salary expected. Address Box 419, AMERICAN MACHINIST.

Wanted—Progressive young draftsman with experience on contractors' hoists and plants; must be capable of following work in factory and reducing costs. Box 420, AM. MACHINIST.

CONNECTICUT

Wanted—First-class operator on Jones & Lamson turret lathe; also one first-class all-around machinist. The New Machine Co., Danbury, Conn.

ILLINOIS

Wanted—Inspector for high-grade machine shop in Chicago; must be able to work from drawings and be an up-to-date man and understand his business thoroughly; state salary and references. Box 421, AMER. MACHINIST.

INDIANA

Wanted—Foreman in bowl-balancing department, correspond with AMERICAN MACHINIST, Box 409.

Increasing force—Wanted, ten lathe men; also three toolmakers; good wages; open shop; steady employment. Western Motor Co., Logansport, Ind.

IOWA

Wanted—First-class diemaker; give experience and references. Address Wagner Mfg Co., Cedar Falls, Ia.

Wanted—High-class mechanic to take charge of tool department of about 15 men in a duplicate-part factory in a small Western city; state experience and length of service with previous employer. Box 411, AMER. MACH.

MASSACHUSETTS

Wanted—Two young men, one a good mechanical designer, the other a first-class shop man and superintendent; should have together a few thousand dollars to go into partnership with an established firm, who will furnish $10,000 additional capital to manufacture and develop a new machine tool. The chance of a life for the right men. Box 435, AMERICAN MACHINIST.

Foreman with successful experience in manufacturing small brass and steel parts, such as typewriter, electrical or brass novelties of any kind, made in large quantities; must have a practical experience with presses, screw machines, tapping machines, etc., and show a successful record in handling boys and girls, planning work and turning out perfect product. Start as inspector at not over $3.50 per day. Opportunity to advance as rapidly as competent to $1500 or $2000 job. Give details of experience and employers for the past three years, which will be considered confidential. Box 445, AMERICAN MACHINIST.

MISSOURI

Wanted—Machinists, electricians, engineers and firemen, do you want to "get wise?" Send for 52-page pamphlet containing questions asked by different Examining Boards; sent free. Geo. A. Zeller Book Co., 53 South 4th street, St. Louis, Mo.

NEW JERSEY

Draftsmen—On general industrial plant extension, furnaces, mill buildings, pumping layouts, machinery repairs, etc.; state age, experience, initial salary and references. "General," AMERICAN MACHINIST.

Wanted—Tool, die and instrument makers accustomed to accurate, complicated work; steady work and good wages to thoroughly competent men; give references. Address Box 438, AMERICAN MACHINIST.

We are increasing our tool-making department and solicit applications from toolmakers and machinists who are experienced on fine and complicated work. Apply to Victor Talking Machine Co., Camden, N. J.

We have increased our plant and desire floor and vise hands for day work and lathe hands for night work. Good pay and steady work for good men. Address or apply at Pond Machine Tool Co., Plainfield, N. J.

As we are continually adding to our departments, we have openings for men familiar with engines and pumping machinery; we require lathe, planer, shaper, drill and vise hands, also erectors for inside and outside work; good pay and steady work to good men. Address communications to Henry R. Worthington, Harrison, N. J.

NEW YORK

Agents wanted in all shops within 150 miles of New York; little work required. Box 436, AMERICAN MACHINIST.

Wanted — Experienced draftsmen, toolmakers and machinists; give age, references and wages expected. Remington Arms Co., Ilion, N. Y.

Draftsmen on jigs and fixtures for duplicating work; none but experienced men wanted; good pay for right men. Mergenthaler Linotype Co., 20-24 Ryerson St., Brooklyn, N. Y.

Wanted after Jan. 1, 1907, some competent millwrights; applicants must state wages expected and when they can start work. Address A. A. P. C. W., Alsen, Greene Co., N. Y.

Wanted — Tool-room foreman, capable of handling 25 men on accurate work; please state age, experience in full, wages expected and references. Address Box 384, AM. MACH.

Wanted — Immediately, machinists; applicants must state experience, wages expected, and time when they can commence work. Apply to A. A. P. C. W., Alsen, Greene Co., N. Y.

Wanted—First-class detailer; must be rapid and accurate; in answering give full particulars as to age, experience in detail and salary required; position will be permanent for the right man. Box 440, AMERICAN MACH.

Foreman wanted—A man who is a practical mechanic and is capable of handling young help on small interchangeable clock work; good wages, with chance for advancement, to the right man. Box 422, AMER. MACHINIST.

Wanted—By large manufacturer of electric hoists and cranes, a first-class erector who has had charge of important work and had several years' experience; write, stating age, experience and salary desired. E. C., AM. M.

Wanted—Competent superintendent for a manufacturing plant within 50 miles of New York City; please give full information as to previous experience, together with references, amount of salary, etc. Address "A. D.," AMERICAN MACHINIST.

Wanted—One good man in every machine shop to sell Gre-Solvent to his fellow-workers; five to twenty dollars weekly may be earned, according to size of shop. Write us, stating shop where employed. Utility Co., Room 100, 332 Broadway, New York.

OHIO

Wanted — First-class designing draftsman familiar with automatic machinery and power punches; steady position to capable man. Box 588, AMERICAN MACHINIST.

Our growing business constantly requires additional machinists. We build lathes, planers, shapers, drilling machines; good opportunity for machinists. The American Tool Works Co., Cincinnati.

PENNSYLVANIA

Wanted—Ten machinists, general machine and bench hands; also two A-1 patternmakers. Apply to Scottdale Foundry and Machine Co., Scottdale, Pa.

Wanted—Tool, die and instrument makers; also a number of operators on large machine tools. Address Employment Department, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

Draftsmen — Wanted, experienced draftsmen in electrical apparatus, switchboards, transformers, motors and generators; only first-class men need apply; state experience and salary expected. Address Chief Draftsman, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.

The Monotype Company maintains a free school for training young machinists to operate its type casting and composing machines. The demand for monotype operators is so great that it receives more applications for places in its school than can be filled. In making selections these qualifications carry most weight: Character, common sense, experience with automatic machinery (or) printing-office experience, or type-foundry experience. Full particulars will be furnished to inquirers who furnish full particulars about themselves. Lanston Monotype Machine Co., 1231 Callowhill St., Philadelphia, Pa.

RHODE ISLAND

Toolmakers wanted — First-class workmen on jig and fixture work for light high-grade machinery. Permanent employment to competent workmen. Apply to the Taft-Peirce Mfg. Co., Woonsocket, R. I.

WISCONSIN

To cope with the continuous enlargement of our business, first-class machinists, patternmakers, molders and boilermakers can find steady employment. Box 899, Milwaukee.

Wanted—Experienced storekeeper in plant manufacturing heavy machinery and employing about 1200 men; write immediately, stating experience, age and salary desired. Address Box 408, AMERICAN MACHINIST.

Large concern building excavating and railway machinery wants to correspond with first-class mechanical draftsmen with view to filling future vacancies as they occur; wants men now employed; give full experience and reasons for changing; shop experience great advantage; all letters acknowledged and held confidential. Box 919, AMERICAN MACHINIST.

WEST OF MISSISSIPPI

The J. Geo. Leyner Eng. Wks. Co., of Littleton, Colo., are increasing their plant and are in need of good mechanics, machinists, blacksmiths and sheet-iron workers. Littleton is a suburb of Denver, where cost of living is reasonable; superb climate the year round. Address above.

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Whitman & Barnes Mfg. Co., Chicago, Ill.

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Bolts, Coupling

National-Acme Mfg. Co., Cleveland, O.

Bolts and Nuts

National-Acme Mfg. Co., Cleveland, O.

Books, Mechanical

American School of Correspondence, Chicago, Ill.
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Boosters

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Binsse Mach. Co., Newark, N. J.
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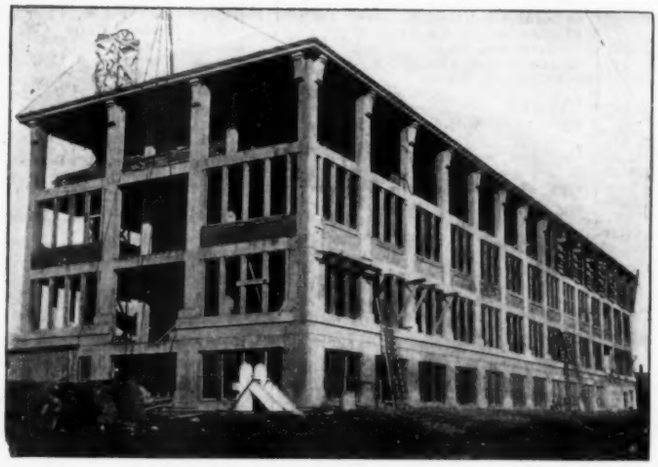
Ridgway Machine Tool Co., Ridgway, Pa.



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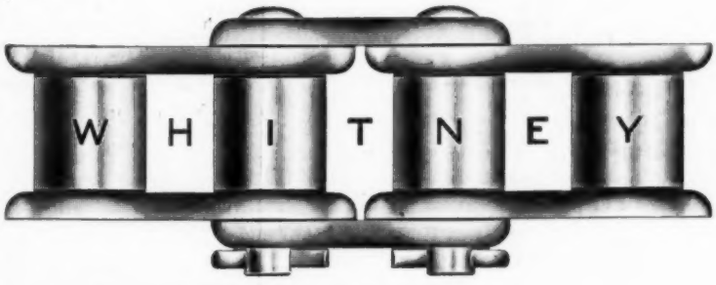

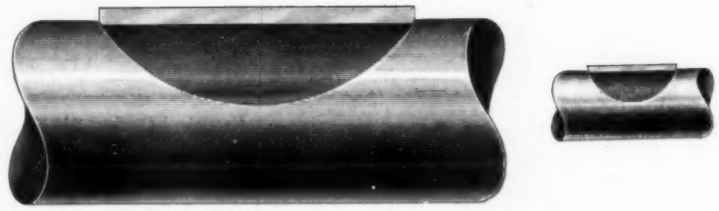

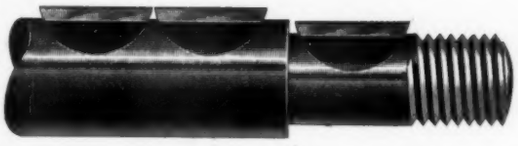

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Slocomb Co., J. T., Providence, R. I.
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See Grinding Wheels.

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Phosphor Bronze & Smelting Co., Philadelphia, Pa.

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Farrel Fdry. & Mach. Co., Ansonia, Conn.
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Poole Co., J. Morton, Wilmington, Del.
United Engineering & Fdry. Co., Pittsburg, Pa.

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Farrel Fdry. & Mach. Co., Ansonia, Conn.

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Clark Cast Steel Cement Co., Shelton, Conn.

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Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
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Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Whiton Machine Co., D. E., New London, Conn.

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Whitman & Barnes Mfg. Co., Chicago, Ill.

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Gisholt Mach. Co., Madison, Wis.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Potter & Johnston Mach. Co., Pawtucket, R. I.
Warner & Swasey Co., Cleveland, Ohio.
Whitcomb - Blaisdell Mach. Tool Co., Worcester, Mass.
Windsor Mach. Co., Windsor, Vt.

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Brown & Co., R. H., New Haven, Conn.
Cleveland Twist Drill Co., Cleveland, O.
Cushman Chuck Co., Hartford, Conn.
Goodell - Pratt Co., Greenfield, Mass.
Horton & Son Co., E., Windsor Locks, Conn.
Jacobs Mfg. Co., Hartford, Conn.
Modern Tool Co., Erie, Pa.
Morse Twist Drill & Mach. Co., New Bedford, Mass.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Pratt Chuck Co., Frankfort, N. Y.
Standard Tool Co., Cleveland, O.
Trump Bros. Mach. Co., Wilmington, Del.
Whitney Mfg. Co., Hartford, Ct.
Whiton Mach. Co., D. E., New London, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

Chucks, Lathe

Cushman Chuck Co., Hartford, Conn.
Gisholt Mach. Co., Madison, Wis.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.
Union Mfg. Co., New Britain, Ct.
Whiton Mach. Co., D. E., New London, Conn.

Chucks, Planer

National Tool Co., Cleveland, O.
Niles-Bement-Pond Co., New York.
Skinner Chuck Co., New Britain, Conn.

Chucks, Split

National Tool Co., Cleveland, O.
Rivett Lathe Mfg. Co., Boston, Mass.

Circuit Breakers

Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Clamps

Billings & Spencer Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.

Clutches, Friction

American Tool & Mach. Co., Boston, Mass.
Caldwell, Son & Co., H. W., Chicago, Ill.
Cresson Co., Geo. V., Phila., Pa.
Eastern Machinery Co., New Haven, Conn.
Evans Friction Cone Co., Newton Centre, Mass.
Johnson Mach. Co., Carlyle, Hartford, Conn.
Link-Belt Co., Philadelphia, Pa.
New Haven Mfg. Co., New Haven, Conn.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Wood's Sons Co., T. B., Chambersburg, Pa.

Coal Handling Machinery

Link-Belt Co., Philadelphia, Pa.

Coils

Standard Welding Co., Cleveland, Ohio.

Compound, Pipe Joint

Dixon Crucible Co., Jos., Jersey City, N. J.

Compressors, Air

Blaisdell Machinery Co., Bradford, Pa.
Blanchard Mach. Co., Boston, Mass.
Bury Compressor Co., Erie, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Ingersoll-Rand Co., New York.
International Steam Pump Co., New York.
Mietz, August, New York.
Spacke Machine Co., F. W., Indianapolis, Ind.

Compressors, Gas

Ingersoll-Rand Co., New York.

Condensers

Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.

Conduit, Interior

Sprague Electric Co., New York.

Cones, Friction

Evans Friction Cone Co., Boston, Mass.

Connecting Rods and Straps

Leard, W. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Contract Work

Blanchard Mach. Co., Boston, Mass.
Chapman & Co., J. B., Springfield, Mass.

Controllers and Starters, Electric Motor

Case Mfg. Co., Columbus, Ohio.
Crocker - Wheeler Co., Ampere, N. J.
General Electric Co., New York.
Stanley-G. I. Electric Mfg. Co., Pittsfield, Mass.
Westinghouse Electric & Mfg. Co., Pittsburg, Pa.

Coping Machines

Bertram & Sons Co., Ltd., John, Dundas, Ontario, Canada.
Long & Allstatter Co., Hamilton, Ohio.
Niles-Bement-Pond Co., New York.

Cork Inserts

National Brake & Clutch Co., Boston, Mass.

Correspondence Schools

See Schools, Correspondence.

Cotters

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Whitman & Barnes Mfg. Co., Chicago, Ill.

Counterbores

Morse Twist Drill & Mach. Co., New Bedford, Mass.
Slocomb Co., J. T., Prov., R. I.

Countershafts

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Builders' Iron Fdry., Prov., R. I.
Evans Friction Cone Co., New Center, Mass.
LeBlond Mach. Tool Co., R. K., Cincinnati, O.
Mossberg Wrench Co., Central Falls, R. I.
Smith Countershaft Co., Boston, Mass.

Countershafts, Friction

Evans Friction Cone Co., New Center, Mass.
Wilmarth & Morman Co., Grand Rapids, Mich.

Countershafts, Speed Changing

Cresson Co., Geo. V., Phila., Pa.
Evans Friction Cone Co., New Center, Mass.
Gisholt Mach. Co., Madison, Wis.

Counting and Printing Wheels

Franklin Mfg. Co., H. H., Syracuse, N. Y.

Couplers, Hose

Ingersoll-Rand Co., New York.

Couplings, Shaft

Almond Mfg. Co., T. R., Brooklyn, N. Y.
Caldwell & Son Co., H. W., Chicago, Ill.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cresson Co., Geo. V., Phila., Pa.
Link-Belt Co., Philadelphia, Pa.
Nicholson & Co., W. H., Wilkesbarre, Pa.
Niles-Bement-Pond Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Standard Gauge Steel Co., Beaver Falls, Pa.
Wood's Sons Co., T. B., Chambersburg, Pa.

Cranes

Alliance Machine Co., Alliance, O.
Brown Hoisting Mach. Co., New York.
Case Mfg. Co., Columbus, O.
Chisholm & Moore Mfg. Co., Cleveland, O.
Cleveland Crane & Car Co., Wickliffe, O.
Crescent Forgings Co., Oakmont, Pa.
Curtis & Co. Mfg. Co., St. Louis, Mo.
General Pneumatic Tool Co., Montour Falls, N. Y.
Maris Bros., Philadelphia, Pa.
Nichols, Wm. S., New York.
Niles-Bement-Pond Co., New York.
Northern Engineering Works, Detroit, Mich.
Obermayer Co., S., Cincinnati, O.
Pawling & Harnischfeger, Milwaukee, Wis.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
United Engineering & Fdry. Co., Pittsburg, Pa.
Vandyck Churchill Co., New York.
Yale & Towne Mfg. Co., New York.

Crank Pin Turning Machines

Niles-Bement-Pond Co., New York.
Underwood & Co., H. B., Philadelphia, Pa.

Crank Shafts

Leard, W. E., New Brighton, Pa.
Standard Connecting Rod Co., Beaver Falls, Pa.
Tindel-Morris Co., Eddystone, Pa.

Crucibles

Dixon Crucible Co., Joseph, Jersey City, N. J.
Obermayer Co., S., Cincinnati, O.

Crushers

Niles-Bement-Pond Co., New York.
Link-Belt Co., Philadelphia, Pa.

Cupolas, and Ladles, Foundry

Obermayer Co., S., Cincinnati, O.
Paxson Co., J. W., Phila., Pa.
Stevens, F. B., Detroit, Mich.

Cups, Grease

Lunkenheimer Co., Cincinnati, O.

Cut Meters

Warner Instrument Co., Beloit, Wis.